The Liquid Pipeline Industry in the United States:

Where It's Been

Where It's Going

A Report prepared for the
Association of Oil Pipe Lines
by
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About the Author

Richard A Rabinow retired from ExxonMobil Pipeline Company on April 1, 2002 after almost 34 years of service with ExxonMobil and its predecessors. Early in his career Mr. Rabinow held various assignments in the refining and supply functions, including the position of Manager of the Baytown Refinery during the mid-1980s. Thereafter he served as the Manager of the Office of Corporate Affairs and Manager of Environment and Safety for Exxon Company, USA.

Mr. Rabinow's association with pipelines began in 1993 when he served on the steering committee for an operational assessment of the Trans Alaska Pipeline System. A subsequent loan assignment as Senior Vice President of the Alyeska Pipeline Service Company was followed by his transfer to the Exxon Pipeline Company (EPC) and in early 1996 he was elected President. During his seven years as president of EPC and ExxonMobil Pipeline Company Mr. Rabinow also served on the TAPS Owners Committee, including a two-year term as Chairman, and on the Boards of Plantation Pipe Line Company and Yellowstone Pipeline Company. He also was active in AOPL and API activities and served a term as Chairman of AOPL.

Mr. Rabinow was educated at Lehigh University where he earned a Bachelor's Degree in Engineering Mechanics and at the Massachusetts Institute of Technology where he received Master's Degrees in Mechanical Engineering and in Management.

Overview: The Liquid Pipeline Industry

Critical Infrastructure: Stability, Diversity, and Safety for America's Energy Supply

The US liquid pipeline industry is large, diverse and vital to the economy. Comprised of approximately 200,000 miles of pipe in all of the fifty states, liquid pipelines carried more than 40 million barrels per day, or 4 trillion barrel-miles, of crude oil and refined products during 2001. That represents about 17% of all freight transported in the US, yet the cost of doing so was only 2% of the nation's freight bill. Approximately 66% of domestic petroleum moves by pipeline, with marine movements accounting for 28% and rail and truck the balance. An illustration of the low cost of pipeline transportation is the 3¢ per gallon cost to move a barrel of gasoline from Houston, Texas to New York Harbor, a small fraction of the cost of gasoline to the consumer.

Pipelines may be small or large, up to 48" in diameter, but with only minor exceptions all of the pipe is buried. Some lines are as short as a mile, while others may extend 1000 miles or more. Some are very simple, connecting a single source to a single destination, while others are very complex, having many sources, destinations and inter-connections. Most pipelines cross one or more state boundaries (interstate) while some are located within a single state (intrastate), and still others operate on the Outer Continental Shelf and may or may not extend into one or more states. US pipelines are located in coastal plains, deserts, arctic tundra, mountains and more than a mile beneath the surface of the Gulf of Mexico.

The materials carried in liquid pipelines embrace a wide range of liquids. Crude systems gather production from on-shore and off-shore fields, while transmission lines transport crude to terminals, inter-connection points and refineries. The crude oil may be of domestic origin or imported. Refined petroleum products, including motor gasoline, aviation fuels, kerosene, diesel fuel, heating oil and various fuel oils, whether produced in domestic refineries or imported to coastal terminals, are sizable portions of the pipelines business. Other materials include petrochemical feed stocks and products and natural gas liquids (NGLs), including propane, which are often referred to as highly volatile liquids (HVLs) because they are gases at atmospheric temperature and pressure, but liquids under the higher pressures in pipelines. Still other pipelined materials include carbon dioxide and anhydrous ammonia and some liquid pipeline companies operate lines carrying nitrogen, oxygen, and occasionally small amounts of natural gas. However, non-liquid pipelines handle almost all natural gas transmission and distribution.

Pipeline companies are structured and owned in many ways. Pipelines may be organized as stock corporations, partnerships, master limited partnerships (MLPs), limited liability companies (LLCs) and sometimes combinations of those forms. Many lines have a single owner who might be an independent company, an integrated energy company, a large company with interests in businesses other than energy, a non-affiliated liquids shipper or an individual investor. In addition, there are numerous pipelines that are jointly owned by some combination of the entities that own pipelines by themselves.

Meeting the future: increased safety and security through voluntary initiatives and regulatory oversight, with a new focus on community involvement.

With few exceptions liquids pipelines are common carriers and the rates charged and the terms and conditions of the services are regulated by the Federal Energy Regulatory Commission (FERC) for interstate lines and similar state agencies for intrastate lines. The Office of Pipeline Safety (OPS) in the Department of Transportation provides most operational oversight, although other federal agencies, such as the EPA and the Minerals Management Service, play important roles. State agencies regulate intrastate lines and local jurisdictions become involved with a variety of matters, including siting and emergency response in the event of an incident.

The liquid pipeline industry has made significant progress over time in reducing the number of safety incidents and oil spills and the volume of oil spilled, although the long term objective of no incidents and no spillage remains elusive. The years 2000 and 2001 each represented record performance. The year 2002, while not another record, sustained the lower level of incidents and volume spilled. A number of voluntary initiatives and regulatory pressures are helping to meet ever increasing industry and public expectations.

The outlook during the first 25 years of the 21st Century is for US petroleum product demand to increase 9.5 million barrels per day (48%) with 2/3 of the growth being for transportation fuels. During that time inland crude production is expected to decline 900 thousand barrels per day, mostly in Texas, Louisiana, Oklahoma and the Rocky Mountain states, while Gulf of Mexico production likely will increase by 500 thousand barrels per day. And the forecast shows refining capacity growing 3.3 million barrels per day, mostly in Texas and Louisiana. That outlook would necessitate imports growing substantially, with crude up 4 million barrels per day and refined products up 6.3 million barrels per day. During the same period significant growth is expected in the petrochemical industry.

The implications of the outlook are significant for the liquid pipeline industry. With regard to crude transportation, it will be necessary to add large, expensive lines in the Gulf of Mexico, to add numerous large, short lines between marine terminals and coastal refineries and to add crude transmission infrastructure in the Midwest, to handle increased Canadian imports, and along the Texas/Louisiana Gulf Coast. Disinvestment in inland crude gathering systems and associated crude transmission systems will occur, as will redeployment and re-investment in many areas of the country.

Forecast: Market growth, infrastructure expansion, realignment, and more new technologies

For refined product transportation the implications include expansions, some significant, to move imported product from coastal terminals to inland consumption points and major expansions of product transmission capacity from Texas/Louisiana Gulf Coast refining centers to the Southeast and the Midwest and to a lesser extent to Arizona, California and the Rocky Mountain region. The situation is likely to be complicated by a continuing proliferation in the number of grades of product. And the network of pipelines providing feedstock and carrying petrochemical products, especially along the Texas/Louisiana Gulf Coast will expand rapidly.

The growing reliance of our nation on petroleum products has other implications for the liquid pipeline industry. To accommodate substantial pipeline growth the availability of suitable rights-of-way, despite increasing urbanization, will be necessary. And, it is imperative that the existing infrastructure continue to be well maintained and the aging network of pipelines be selectively upgraded and replaced. Technology and effective management systems will be keys to accomplishing that, while assuring safe, environmentally sound and reliable operations.

There are several key points to keep in mind:

- The liquid pipeline industry will grow significantly during the next 25 years, although not so much as the natural gas pipeline system

- The industry is extremely diverse and is becoming more so, especially with the rapid growth of Master Limited Partnerships (MLPs) and the decreasing role of major integrated energy companies

- The pipeline industry is extremely competitive, and becoming more so, and there is a decreasing need for traditional economic regulation

- Technology will play an essential role in continuing to improve the safe, environmentally sound and reliable operation of liquid pipelines and to effectively deal with the challenges of an aging infrastructure

- Land use issues will be a major factor in acquiring rights-of-way that will be essential to expanding and reorienting the pipeline network to meet the nation's needs in the years ahead

Exhibit 1 Fact Sheet US Liquid Pipeline Industry

Mileage	Crude oil trunk lines (usually 8" to 24"; up to 48")	55,000 miles
	Crude gathering (small lines; mostly TX/OK/LA/WY)	30 to 40,000 miles
	Petroleum products	95,000 miles
	Total liquid pipelines	Approx 200,000 miles
Jurisdictional measures	Federal Energy Regulatory Commission (FERC) - CY2000	195 interstate pipelines
		168,417 miles Revenue = $6.26 Billion
	Office of Pipeline Safety, Dept of Transportation (OPS)	150,000+ miles
Petroleum transported	Total oil transported in pipelines (2001)	40+ million barrels per day 575+ billion ton-miles 4 trillion barrel-miles
Cost of pipeline transportation	Example: Houston, Texas to New York Harbor	Approx $1.25 per barrel Approx 3 ¢ per gallon
Proportion of US freight	Oil shipments as fraction of total freight	17%
	Cost as fraction of total national freight cost	2%
Mode of transportation (2001)	Pipelines	66%
	Water carriers (barges and tankers)	28%
	Trucks	4%
	Rail	2%
Substitution of truck or rail for pipelines	Basis: 150,000 barrel/day pipeline	
	Trucks: 200 barrels (=8400 gallons) each	750 trucks per day 1 arrives/unloads every 2 min
	Unit train of 2000 barrel tank cars	75 car train every day
Decade of construction	Pre-1930s	2%
	1930s	7%
	1940s	13%
	1950s	22%
	1960s	23%
	1970s	17%
	1980s	9%
	1990s	7%
	2000+	less than 1%
Oil spillage	Main-line pipe	Approx 1 gal per million barrel-miles Less than 1 tsp per thousand barrel-miles

Themes

1. The Liquid Pipeline Industry is Extremely Diverse

Although the concept of a liquid pipeline is simple and straight forward, the reality is that the liquid pipeline industry in the United States is extremely diverse, in just about any way that one might attempt to measure the industry. For example:

- Size: Pipeline diameter can be as small as a few inches or as large as 4 feet, length can range from less than a mile to more than 1000 miles and the line can be a pipe of uniform dimension or comprised of sections of multiple diameters or even parallel, interconnected pipes

- Geography: Pipelines can be situated solely in one state, can cross many states, can operate entirely in federal waters outside any state or involve some combination of federal waters and one or more states. Pipelines operate in urban as well as remote areas, in arctic tundra, in deserts, in coastal plains, in mountains and deep under the surface of coastal waters.

- Commodities carried: Pipelines can be dedicated to transporting single commodities, such as crude oil, motor gasoline, jet fuel and propane, or can carry a range of different commodities or of distinct grades of a single commodity; a typical large product pipeline carries 30 to 50 products regularly

- Complexity: Some pipelines carry material from a single source to a single destination while others have many sources, destinations and connections to other pipelines

- Shippers: Some pipelines have a single shipper while others have dozens of shippers; some shippers have an affiliation with the pipeline while others have none

- Types of services: While the basic service provided by a pipeline is transportation from one point to another, other services can be provided such as treating, blending and storing materials and operating and maintaining pipeline facilities for others

- Corporate structure: Pipelines may be organized as stock corporations, partnerships, Master Limited Partnerships and Limited Liability Companies

- Ownership: Some pipelines are wholly owned by a single entity, sometimes by an integrated energy company and also by other entities in and out of the energy business; other pipelines have multiple ownership where the owners might be other pipeline companies, other energy companies, various other corporate entities, investor groups or individual investors

Given the wide range of situations, from a small pipeline with a single owner, carrying a single material for a single customer, to large companies owning and operating thousands of miles of pipe in many states and in federal waters and carrying a long list of commodities for one hundred or more shippers, it is difficult to establish and administer policy in ways that are fair and equitable to the wide range of industry participants. Inasmuch as there exist subjects for which regulation is essentially non-discretionary, it is important that the industry's diversity be recognized and understood so that whatever regulation is imposed will be as effective as possible in meeting its objectives.

2. Decisions are Driven by Economic Analyses

Today, every pipeline entity, whether a small, independent operator or a part of a large, integrated oil company, makes decisions that are driven by similar business and economic analyses. Simply put, virtually every pipeline entity uses a similar process to make decisions, although the details of the analysis, the sophistication of the tools employed and the judgments and assumptions vary. The common elements of the analytical process are:

- The <u>costs</u> to construct operate and maintain the pipeline or segment in question

- The <u>revenues</u>, considering volumes, tariffs, seasonality and other variability over time that can be expected to be associated with the pipeline or segment being studied

- The <u>competition</u>, as it exists and as it may change in response to the project under study and to other factors

- The <u>business risks</u> associated with the venture, which include the cost and schedule for executing a project, changes to the cost and revenue projections, legislative and regulatory changes, and the consequences of any operational incidents

- The inclusion of a <u>profit component</u> that provides a return to the investor, be it an individual or a large corporation, and is reflective of the cost of capital to the investor, the perceived risks involved and the alternative investments available

Every pipeline operator considers those factors when deciding whether to go forward with a project or whether to retain a particular business segment. Some may be more optimistic than others regarding cost, revenues and the longer term outlook, some may require a higher or lower return component and there may be differences of opinion regarding the level of risk, but everyone considers the same factors. Contrary to what some may believe, even the pipeline companies that are a part of large, integrated oil companies must consider those factors and their decisions must be economically sound. The time is past; if in fact it ever existed, that the pipeline segment in an integrated company will make an unsound business decision because it is partly or wholly owned by a company that has other interests as a potential shipper.

3. The Liquid Pipeline Industry is Increasingly Proactive Regarding Environmental, Safety and other Matters of Public Interest

For a number of years the leadership of the liquid pipeline industry has been acutely aware of the importance of meeting or exceeding the public's expectations regarding environmental and safety performance. While the industry would argue that it always has striven for excellent operations, there were factors in the past, such as the state of technology, the level of performance standards, the then existing best practices and the priorities of the business, that did not provide the emphasis that operational excellence has achieved during recent years.

During the 1980s, there were a number of major incidents (including the chemical release in Bhopal, India and the propane explosion in Mexico City which together killed thousands of people and the Valdez, Alaska oil spill) that had a profound impact on the petroleum and petrochemical industries. There also have been widely reported incidents involving liquid and natural gas pipelines (including Brenham, Texas, Edison, NJ, Colonial Pipeline spills and the Bellingham, Washington explosion and fire) that brought home a recognition that pipelines, too, needed to respond and to improve operations. The overall response has been to alter priorities and to systematically re-examine operations with an eye to fundamentally improving the way pipelines are constructed, maintained and operated.

The general approach has been to develop and implement a set of management systems that cover all aspects of operations and virtually everything associated with them. Thus it starts with the leadership role of management, includes the selection, training and qualification of employees and contractors, the building, maintaining and operating of pipelines, risk assessment, the application of enhanced technology and incident prevention and response and ends with system evaluation and continuous improvement. As with most such broad initiatives, some companies became involved earlier than others, but with the passage of ten or more years virtually everyone is actively engaged. And the results show it, although everyone would be quick to acknowledge that the level of perfection expected by the public is not yet being met regularly.

During the mid-1990s alignment was built across the leadership of the liquid pipeline industry and a variety of initiatives were begun to further improve the industry's performance. Until then the pace of improvement had been slower than desired; and there was a need for a step change improvement. Perhaps the most significant action that was taken was the establishment of a voluntary industry program, the Pipeline Performance Tracking System (PPTS), to record virtually every spill incident in keeping with a belief that something must be measured for it to be managed. That voluntary effort has been in place for several years, significant improvement is being seen and the federal safety regulatory agency recently adopted a reporting program similar to what the industry instituted. PPTS was not the only initiative. Others relate to better training for employees, better information for use by pipeline companies, regulators and emergency responders, research seeking to identify better tools and techniques and encouraging Congress and the regulators to adopt enhanced legislation to ensure uniform compliance.

4. Right-of-Way Matters have become Major Challenges

During most of the early history of the liquid pipeline industry the acquisition of rights of way for pipelines was relatively easy, reflecting routes that were mostly in sparsely populated, rural areas and the generally understood need to move crude oil from producing areas to refineries and products from refineries to consumers. In recent decades the situation has changed considerably, as the United States has become increasingly urbanized and the interests of the land owner and the oil industry have deviated. Today, the acquisition of rights of way can take extended periods, often much longer than the time required to construct a pipeline, involves difficult and time-consuming negotiations, is increasingly costly and often ends in litigation that can drag on for years and sometimes a decade or more. The outlook is for the situation to become even more difficult, time-consuming, costly and litigious. And this is true everywhere, even in areas such as Texas that are commonly thought to have close affinities to the petroleum industry.

There appear to be two basic factors that are driving the changes, one being financial interests and the other being safety concerns. Few land owners today have any vested interest in the petroleum industry; rather they desire to maximize the return from their land. So, if a pipeline crosses their property or if a new line is routed across it, their desire is to gain as large a payment as possible for granting access and most land owners are prepared to take whatever steps are available to bolster their case. Thus, dueling appraisals, the retention of specialized, sophisticated attorneys, protests before regulatory bodies and legal challenges are all part of the efforts to extract higher value for providing an easement to a pipeline. Others are concerned about the potential for safety incidents that could arise from a pipeline in close proximity to their homes, the schools their children attend, their places of business and so forth. They also express concern that the value of their property will be diminished by the presence of a pipeline easement. Despite the improving safety and environmental performance of pipelines, the relatively few significant incidents receive widespread and graphic coverage and foster the NIMBY (Not in My Back Yard) philosophy that many industrial and public facilities face.

Another aspect of the right-of-way challenge is the effective management of existing easements. Despite the existence of safety concerns, land owners typically seek to limit the width of easements and to fight constraints on their use of the land immediately over the buried pipeline. A large body of historical data demonstrates that the single largest cause of pipeline safety incidents and spills is damage to pipelines by third-parties when they excavate, farm or conduct other activities in the rights of way. As a result there is a major effort underway by the pipeline industry and other interested parties (such as excavation contractors, regulatory bodies, telecommunications companies and utilities) to develop better ways to build and mark pipelines (and other underground utilities), to inform contractors and the public about the need for caution when working on or near easements, to enhance the nation-wide one-call system, to eliminate physical encroachments onto easements and to implement land use planning standards to reduce the risk of incidents from intrusions onto the rights-of-way.

5. Economic Regulation is Costly

The economic (i.e. rate) regulation of liquid pipelines is costly and it is questionable whether the regulatory structure that has evolved over a long period is still needed or justified. For the last decade pipeline rates have been set under four approved methodologies. The most common method has been to adjust rates according to a FERC-set index that uses an inflation factor to establish a ceiling for any rate. Alternatively, pipelines (1) may negotiate rates if all shippers using the service concur; (2) may use the market-clearing price provided that FERC has found the pipeline lacks market power in the effected origin and destination markets; or (3) may apply for traditional cost-of-service treatment. Shippers may also request a cost-of-service review of rates. Under the rules of common carriage applicable to all pipelines, the same rate must be charged to all similarly situated shippers. Of the various available methods, the least used, since the inception of indexation, has been cost-of-service. However, as pipeline assets change hands more rates are being challenged, which leads to more cost-of-service reviews being conducted and moves liquid pipelines closer to utility-type regulation than ever before.

Any analysis of the cost of regulation should start with the direct costs, which are significant, including employees of the pipeline companies, the regulatory staffs and the fees for lawyers retained by shippers and carriers. Such costs are measured in the tens of millions of dollars annually, but are not the most substantial costs associated with economic regulation. It is the indirect costs that are most significant. One is the opportunity cost of the management time that could be employed for higher economic value in many ways, such as improving operating performance and better serving the needs of shippers. And probably even more importantly, the economic regulation has a chilling effect on investments in new infrastructure. The cost of any large pipeline project is measured in the millions, if not tens of millions, of dollars and uncertainty, which can result from economic regulation, is a major factor in delaying and even avoiding investment. The uncertainty arises because economic regulation is being used to delay projects and to drive down revenues to levels that may not provide adequate returns to the investors.

Once, there might have been an argument that despite the cost, economic regulation was needed for other reasons, such as protecting shippers. However, the pipeline industry has changed over time. Today it is a very diverse, competitive industry, with a large number of companies, an increasing number of large, independent entities (such as MLPs that can tolerate a lower return level because of tax advantages to their investors) and a much diminished participation by integrated majors. Furthermore, the situations of the pipeline companies owned by the majors have changed. Today, each must stand on its own and be judged by its financial and operating performance and virtually no credit is given for service to an affiliate. It is strictly business and an affiliated pipeline company must compete just like its unaffiliated brethren and show results. These changes, which have been underway for years, are accelerating.

A solution to changing economic times would be to limit economic regulation to cases of undue discrimination and otherwise let the marketplace set the appropriate level of pipeline rates. Maintaining some requirement for pipelines, such as to publish tariffs and to provide access under reasonable terms and conditions, should provide acceptable safeguards for all concerned.

Trends

The Need for Liquid Pipelines

Historical Overview

The history of liquid pipelines in the United States can be traced to the late 1800s in Ohio, Pennsylvania and New Jersey. The primary driver for the use of pipelines has always been economic. When oil was discovered and production commenced, crude oil volumes were small and a distributed transportation system, such as horse-drawn wagons, trucks, and railroads, was the most efficient means of transporting the oil to refineries where it would be converted into products desired by oil consumers. As the level of production increased it became economical to invest in pipelines, especially for the transmission lines that would carry the crude to the refineries. Depending upon the level of production in a particular field and the proximity of the wells one to another, producers might continue to use wagons and trucks or decide to invest in pipes to gather the crude.

Exhibit 2. Petroleum Overview 1950 to 2025

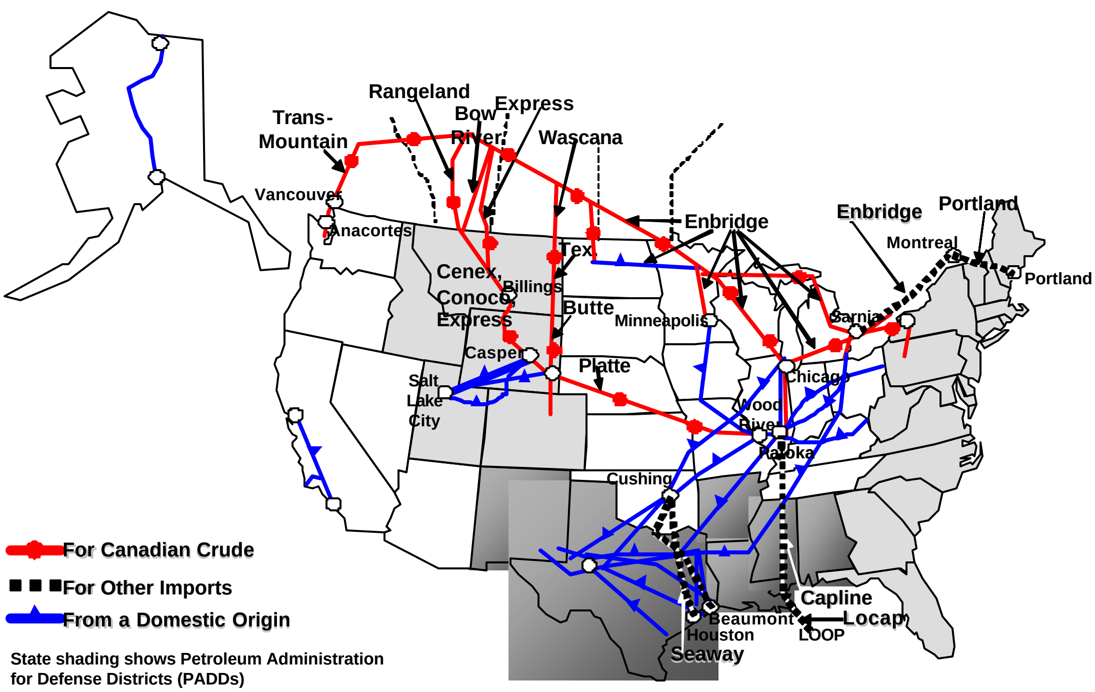
Thousand Barrels per Day

	Crude Oil Production	Crude Oil Net Imports	Total Refinery Input	Refinery Dist. Capacity	Petro. Product Net Imports	Motor Gasoline Supplied	Total Petroleum Product Supplied
1950	5,407	392	6,020	6,220	153	2,616	6,458
1960	7,035	1,007	8,580	9,840	606	3,969	9,797
1970	9,637	1,310	11,750	12,020	1,850	5,785	14,697
1980	8,597	4,976	14,020	17,990	1,388	6,579	17,056
1990	7,355	5,785	14,590	15,570	1,375	7,235	16,988
2000	5,822	9,021	16,300	16,510	1,399	8,472	19,701
2010	5,630	11,510	NA	18,700	2,250	10,690	22,990
2025	5,330	13,060	NA	19,800	6,730	13,770	29,170

Energy Information Administration/Annual Energy Review 2001
Energy Information Administration/Annual Energy Outlook 2003

As the decades passed and exploration and production activities covered much of the US, the need to gather ever larger quantities of crude oil and then to transport that oil to refineries necessitated the construction of a large network of crude oil pipelines, both in-field gathering systems and large transmission lines. That trend continued through much of the twentieth century, peaking in 1970 at 9.4 million barrels of production per day in the Lower 48 states. Thereafter the trend reversed as the production in most inland domestic fields declined and by 2002 Lower 48 production had decreased to 4.8 million barrels per day. As a result, the throughputs in gathering systems and transmission lines declined, sometimes to the point where volumes would no longer support operations, and lines were shut down, abandoned or converted to other uses. Despite the decline in inland production, the demand for crude oil to feed US refineries and ultimately for the consumption of refined petroleum products continued to grow. Those needs, along with improved technology, encouraged production in new areas. A primary growth area has been in ever-deeper waters in the Gulf of Mexico, with offshore production reaching 1.9 million barrels per day in 2001. In addition, the amount of foreign crude imported into the US has continued to grow, reaching 9.1 million barrels per day in 2002. In the decade ahead it can be expected that inland production, both in the lower-48 and in Alaska, will continue to decline, to approximately 1 million barrels per day in 2025, and that the deep-water Gulf of Mexico and foreign sources will provide increasing volumes of crude oil, 2.2 million barrels per day and 13.0 million barrels per day, respectively. Canadian crude imports are expected to grow modestly from 2000 to 2025 (i.e. 300 thousand barrels per day) while Persian Gulf and Mexican/Venezuelan imports are expected to increase 2 million barrels per day and 1.6 million barrels per day, respectively.

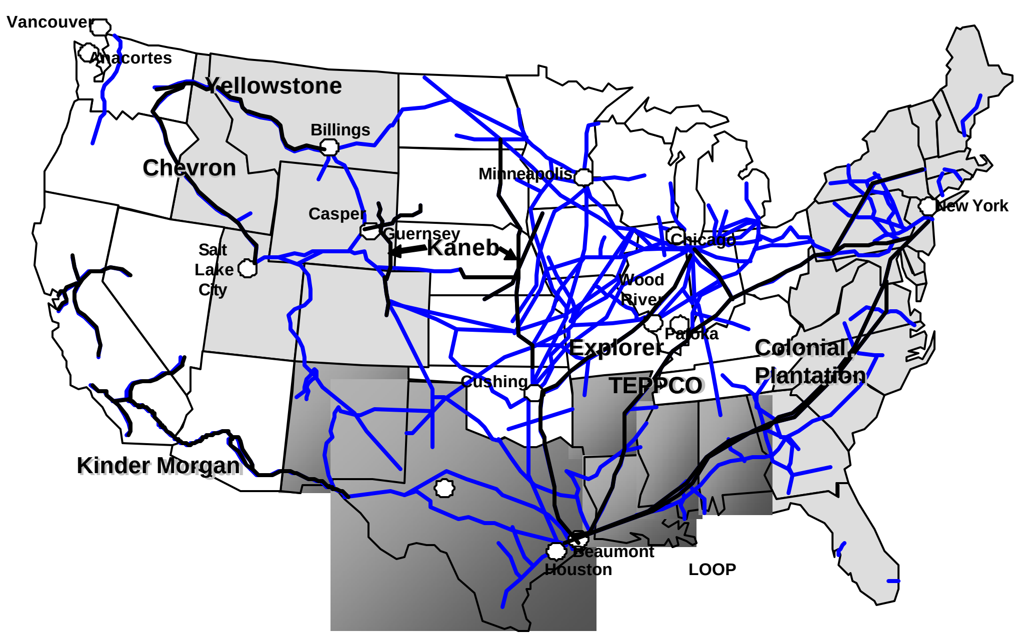
Exhibit 3. Selected Crude Oil Trunkline Systems



From “How Pipelines Make the Oil Market Work,” Allegro Energy Group, December 2001

The consumption of petroleum products has always been widely disseminated and refineries tended to be widely distributed and sized to meet regional needs. For most of the first half of the twentieth century the vast majority of products were transported from refineries in discrete parcels, by trucks, rail cars, barges and tankers. During World War II the first large transmission pipelines for petroleum products were constructed, primarily from the Gulf Coast to the Mid-Atlantic States, driven by the vulnerability of coastal tankers to German U-boats. Since the war, the network of product pipelines has continued to grow. The outlook is for product demand, which was about 20 million barrels per day in 2002, to continue to increase, albeit at different rates in different parts of the country, reaching almost 30 million barrels per day in 2025. The trend for domestic refining capacity is to become more concentrated in regional centers and for imports of petroleum products to grow, reaching 6.7 million barrels per day in 2025 versus 1.4 million barrels per day in 2002. Those factors, including declines in inland crude production and the number of small inland refiners, will provide the impetus for expanding the network of product pipelines.

Exhibit 4. Major Refined Product Pipelines



From "How Pipelines Make the Oil Market Work," Allegro Energy Group, December 2001

The Customers

The circumstances of the petrochemical industry are similar to the refining industry. As plants increased in size it became more attractive to invest in pipelines to transport raw materials to the plants and in other pipelines to transport the products, especially intermediate products (i.e. those needing additional processing into consumer products), to other plants for further processing.

The customers and the commodities in the pipeline industry have changed over time.

Since the inception of the domestic petroleum industry in the late 19th century crude oil producers and refiners have been the primary customers of the liquid pipeline industry. Along the way the marketers of refined petroleum products also became a larger factor. Then, the rapid growth of the petrochemical industry during the second half of the twentieth century created a significant demand for pipelines to transport feed stocks to chemical plants and products from those plants to other plants for further processing. In recent decades other parties have become shippers on the pipelines, including the military, many of the airlines, crude and product importers and traders of crude and petroleum products.

The pipeline business adapts to the products and destinations that are in demand.

For much of the history of pipelines it was not unusual that some sort of affiliation existed between a pipeline and its shippers. The pipeline might have been organized as a separate entity, but its owner was often a parent that also had interests in the production, refining and marketing segments or by a railroad (Buckeye and Santa Fe Pacific). Under those circumstances it was common for a pipeline to work closely with its affiliated producer, refiner and marketer to develop pipeline infrastructure to move crude oil to a market, possibly an affiliated refinery; to transport crude, whether or not produced by an affiliate, to a refinery; and to move products to a market that might or might not be affiliated. A similar situation, but to a lesser extent, existed with petrochemicals inasmuch as the degree of integration of chemicals with petroleum has been considerably less than the integration of petroleum segments alone.

Commercial and military goals are accommodated in this diverse sector.

During the past few decades the extent of integration of pipelines with other segments of the petroleum industry has diminished considerably. Increasingly, and now to a large extent, the integrated companies demand that each segment, including pipeline transportation, stand on its own economically. That has caused the production, refining and marketing arms of integrated companies to look to non-affiliated transportation opportunities and for the affiliated pipeline companies to increasingly look to third party, non-affiliated business. An increasing number of joint ventures, with venture partners including a wide variety of participants, have diminished the situations where it is either practical or economical for a pipeline to deal solely with an affiliate. In addition, there are now many more independent participants in every segment of the petroleum industry and competition in all areas has forced every part of the industry, carrier and shipper alike, to seek the most economical transportation system. Still another factor in diminishing inter-affiliate business is the number of mergers in recent years, which resulted in restructurings that included the disposal of pipeline assets to third-parties for regulatory and financial reasons. There is every indication that the trend of diminished affiliated business will continue and may well accelerate.

The Commodities

Materials carried via pipeline are numerous and varied. Operations have become more sophisticated due to the ever-increasing number of commodities transported everyday.

The list of materials transported by liquids pipelines is long. It starts with crude oil of many different grades and types, covers many refined petroleum products, including motor gasoline, aviation fuels, kerosene, diesel and heating oil and a variety of fuel oils, and a multiplicity of intermediate refinery streams. The list also includes natural gas liquids (NGLs), with propane being an example, and petrochemical feedstocks and products. The NGLs and petrochemical materials are typically referred to as highly volatile liquids (HVLs) since they are gases at atmospheric temperature and pressure, but liquids at the pressures in a pipeline. Other materials transported by liquids pipelines include carbon dioxide, coal slurry and anhydrous ammonia and some lines operated by liquid pipeline companies carry still other materials such as nitrogen, oxygen and hydrogen. In a few instances a liquids company may transport small quantities of natural gas, but natural gas pipeline companies handle virtually all transmission and distribution of natural gas. The number of discrete commodities is increased many-fold by gradations in the base commodity. For example, there are numerous grades of crude oil as a result of the differing properties such as sulfur and density and many grades of motor gasoline reflecting a wide variety of specifications. As an example, one Midwest pipeline operator reports carrying 34 grades of gasoline during a typical 10 day pipeline cycle. Large product pipelines have 30 to 50 products moving regularly and as many as 100 to 120 grades that move occasionally.

Crude oil may be produced domestically, either on-shore or in coastal waters, or may be imported from a foreign source. For the most part, until the second half of the twentieth century, the crude oil processed in US refineries was produced and gathered at inland fields in the US. The early production was predominantly in Pennsylvania and Ohio, but over time there were large finds in East Texas, West Texas, Oklahoma, Louisiana, California, Alaska and the Rocky Mountains and smaller discoveries elsewhere. It became economical to invest in pipeline infrastructure to gather the crude and then transport it to refineries as the production in any region increased.

As demand for petroleum products grew during World War II, and especially in the decades thereafter, tripling between 1950 and 2000, the consumption of crude grew from 6.0 million barrels per day in 1950 to 16.2 million barrels per day in 2002. During the decades of the 1940s, 1950s and 1960s domestic production increased to meet those needs, helped by controls on crude oil imports because economics favored foreign crude. By the early 1970s crude production was essentially at capacity at about 9 million barrels per day and controls were eliminated. During that post-war period, liquid pipelines rapidly increased their capacity to transport crude to the growing refining centers, particularly on the Texas/Louisiana Gulf Coast.

Exhibit 5.
Crude Oil Production and Oil Well Productivity 1950 to 2025

Thousand Barrels per Day

	GEOGRAPHIC LOCATION		SITE		TOTAL	Producing Wells	Average Production
	48 States	Alaska	Onshore	Offshore		(Thousands)	(Barrels per day)
1950	5,407	0	NA	NA	5,407	NA	NA
1960	7,034	2	6,716	319	7,035	591	11.9
1970	9,408	229	8,060	1,577	9,637	531	18.1
1980	6,980	1,617	7,562	1,034	8,597	548	15.7
1990	5,582	1,773	6,273	1,082	7,355	602	12.2
2000	4,851	970	4,049	1,773	5,822	534	10.9
2010	4,980	640	3,150	2,470	5,630	NA	NA
2025	4,160	1,170	3,150	2,180	5,330	NA	NA

Energy Information Administration/Annual Energy Review 2001
Energy Information Administration/Annual Energy Outlook 2003

Exhibit 6. Petroleum Imports and Exports 1950 to 2025

Thousand Barrels per Day

	CRUDE			PETROLEUM PRODUCTS			TOTAL		
	Imports	Exports	Net	Imports	Exports	Net	Imports	Exports	Net
1950	487	95	392	363	210	153	850	305	545
1960	1,015	8	1,007	799	193	606	1,815	202	1,613
1970	1,324	14	1,310	2,095	245	1,850	3,419	259	3,161
1980	5,263	287	4,976	1,646	258	1,388	6,909	544	6,365
1990	5,894	109	5,785	2,123	748	1,375	8,018	857	7,161
2000	9,071	50	9,021	2,389	990	1,399	11,459	1,040	10,419
2010	11,580	60	11,510	3,250	1,000	2,250	14,830	1,060	13,760
2025	13,110	50	13,060	7,830	1,100	6,730	20,940	1,150	19,790

Energy Information Administration/Annual Energy Review 2001
Energy Information Administration/Annual Energy Outlook 2003

The logistics of crude supply began to change in the 1970s and the trends that emerged have continued until now. Inland production has been essentially maximized and most inland fields are in significant decline if not depleted. Domestic exploration efforts have moved to more remote locations, with notable success on the North Slope of Alaska in the late 1960s and early 1970s and into ever deeper water in the Gulf of Mexico, with recent activity in 5,000 feet to 10,000 feet of water. There were other successes, such as heavy crude oil expansion in California, along the California coast and in the Rockies, but none matched Alaska or the Gulf of Mexico. The result of an increasing total demand for crude and a decreasing ability to supply that need domestically has caused crude imports to grow very significantly, reaching more than 9 million barrels per day, and accounting for some 60% of all crude oil refined in the US.

The impact on pipelines of the changes in crude supply has been significant. Gathering activities have diminished in virtually all inland areas, with systems being shut-down and abandoned, trucking replacing the use of pipelines, the remaining gathering systems being consolidated and ownership changing with the integrated and other larger companies being replaced with smaller, more specialized and often new companies. At the same time many of the crude transmission lines from the inland fields are no longer needed and are being taken out of service, to be converted to other uses or abandoned. Often, those that remain are operating at considerably less than capacity.

Growth in Canadian crude imports

While those changes were occurring in inland areas, other developments were taking place. Crude imports, largely to Gulf Coast, Atlantic Coast and upper Mid West refineries, grew rapidly. Marine terminals grew and relatively high-capacity but short pipelines were put in place to handle the coastal imports, while new and expanded transmission lines were built to move approximately 1.8 million barrels per day of Canadian crude to the US, especially to the upper Midwest. The pressure to move Canadian crude further south in the US triggered several of the largest pipeline expansions (i.e. Express, Enbridge, etc.) of the late 1990s and early 2000s.

The Trans Alaskan Pipeline System (TAPS) is 800 miles long.

During the 1970s a large transportation system, involving the 800 mile, 48” diameter Trans Alaska Pipeline System (TAPS) and a fleet of ocean-going tankers, was established to move North Slope crude to market, mostly on the West Coast, but for the 1980s and much of the 1990s to Gulf and Atlantic coast refineries as well. With the decline in Alaska production (TAPS throughput is currently at about 1 million barrels per day versus a peak in excess of 2 MB/D in 1988) the West Coast is once again seeing an increase in crude imports (750 thousand barrels per day).

The other major crude logistics development that is underway and is likely to continue throughout the next decade is the gathering and transportation of deep-water Gulf of Mexico production. For example, a 153-mile line of 18” and 20” pipe in the Western Gulf was completed in 2000 that transports crude gathered in 5000 feet of water. Even larger systems in the Central Gulf, such as Caesar and Proteus, are under development currently in even deeper water. The demands for capital and technology enhancements are significant and government policy is encouraging the growth in a safe and economic way.

Exhibit 7. Refineries: Input & Output and Number, 1950 to 2025								
Million Barrels per Day								
	INPUT		OUTPUT			REFINERIES		
	Crude Oil	Total	Motor Gasoline	Distillate Fuel Oil	Total	Number	Capacity	Utilization (%)
1950	5.74	6.02	2.74	1.09	6.02	320	6.22	92.50
1960	8.07	8.58	4.13	1.82	8.73	309	9.84	85.10
1970	10.87	11.75	5.70	2.45	12.11	276	12.02	92.60
1980	13.48	14.02	6.49	2.66	14.62	319	17.99	75.40
1990	13.41	14.59	6.96	2.92	15.27	205	15.57	87.10
2000	15.07	16.30	7.95	3.58	17.24	158	16.51	92.60
2010	17.14	NA	NA	NA	NA	NA	18.70	93.20
2025	18.39	NA	NA	NA	NA	NA	19.80	94.60
Energy Information Administration/Annual Energy Review 2001								
Energy Information Administration/Annual Energy Outlook 2003								

Throughout the early decades of the petroleum industry, refined products were manufactured at small to medium sized refineries located relatively close to the product markets. In that environment there was a heavy reliance on rail, barge, small coastal tankers and some limited scope pipeline systems to move the products from refineries to distribution terminals and then to use trucks to move the product the final step to service stations or to the customer directly. During World War II the combination of growing demand and submarine warfare led to the development of large pipelines to move products to the East Coast from the refining centers that were situated near the large supply of domestic crude along the Texas/Louisiana Gulf Coast. After the war, as the economy grew rapidly and the demand for products, especially motor gasoline, increased there were many expansions and additions to the network of product transmission pipelines. For example, the volume of oil moved by pipeline increased 42% between 1970 and 2002. However, the need remains for truck, and sometimes for rail, transportation to get products to the consumer. The seemingly ever-increasing demand for petroleum products continues to provide a need for more capacity in the transportation system and that is likely to be the case into the foreseeable future.

The transportation of petroleum products also has become more complex. The proliferation of product grades during recent decades, especially for gasoline, has been a complicating factor that required expanding the number of segregations in the material being shipped. There are capacity, cost and product quality implications of the multiplicity of grades. When there is sufficient volume, the simplest and least expensive pipeline operation would be a dedicated line, but rarely is the product volume large enough. Thus operators resort to batching --- shipping a sequence of discrete products (or batches). Care must be taken to maintain isolation between batches and any interface between successive batches must be down-graded (say premium gasoline into regular) or reprocessed. Sometimes the size of batches can be increased, lowering the transportation cost, if more than one shipper is agreeable to meeting a common specification (i.e. a fungible product).

Exhibit 8. Petroleum Products Supplied by Type 1950 to 2025

Thousand Barrels per Day

	Motor Gasoline	Jet Fuel	Distillate Fuel Oil	Residual Fuel Oil	Asphalt & Road Oil	Other Products	Total
1950	2,616	NA	1,082	1,517	180	1,063	6,458
1960	3,969	371	1,872	1,529	302	1,754	9,797
1970	5,785	967	2,540	2,204	447	3,721	14,697
1980	6,579	1,068	2,866	2,508	396	3,639	17,056
1990	7,235	1,522	3,021	1,229	483	5,020	16,988
2000	8,472	1,725	3,722	909	525	4,348	19,701
2010	10,690	1,900	4,610	600	NA	5,190	22,990
2025	13,770	2,740	5,870	640	NA	6,150	29,170

Energy Information Administration/Annual Energy Review 2001

Energy Information Administration/Annual Energy Outlook 2003

Motor gasoline

Motor gasoline accounts for about half of the volume of U.S. petroleum products consumption (8.8 million barrels per day out of 19.8 million barrels per day total in 2002). Once there were typically two or three grades of gasoline differentiated by their octane levels and in some parts of the country, particularly the northern areas, there were seasonal variations summer versus winter. Today there is a multiplicity of grades (as many as 30 to 40 according to a recent survey by the American Petroleum Institute), some specific to a particular region, state, county or even locality. Those changes have made pipeline operations more difficult, reduced the effective capacity of the existing transportation system, necessitated capital investment and generally raised costs. There seems to be no change in this trend and, if anything, the proliferation is likely to continue. For instance, a number of states are prohibiting gasoline containing MBTE and are requiring certain specific ethanol blends.

Trans-portation fuels

Other significant transportation fuels include jet and diesel fuels, accounting for more than 25% of total product demand in 2002. Whereas aviation gasoline was once the predominant aviation fuel and later naphtha-based jet fuel was the primary military aviation fuel, they have been superceded by kerosene based jet fuel, much of which is transported by pipeline for at least part of its journey to the consumer. As with gasoline, there are a growing number of grades of these fuels, with the advent of a very low sulfur diesel fuel in the near future posing many issues and concerns for the pipeline industry.

The remainder of the product barrel is comprised of other fuels, such as kerosene, heating oil, and a variety of heavier, higher-sulfur fuels. The lighter fuels (i.e. kerosene and heating oil) are often transported in batches with gasoline and other transportation fuels, whereas the heavier, dirty fuels, such as asphalt and heavy fuel oil, are much less compatible with the lighter fuels and are usually

Today's Marketplace demands safe transportation for "clean fuels," agricultural and industrial solvents, and many other liquids. Each commodity requires skillful handling and modern equipment.

transported in separate pipeline systems, which tend to be of limited scale in terms of size and distance covered. The higher viscosity materials also require special handling. Historically the lighter fuels were called "clean fuels", but in recent years the term "clean fuels" has been applied to fuels that have been further refined to remove impurities, such as sulfur, that will enable them to be "clean burning".

The natural gas liquids (NGLs) cover a range of materials, including ethane, propane, butane and mixtures of them, that are gases at atmospheric temperature and pressure, but liquids at the operating pressures in pipelines. Propane (or liquefied petroleum gas --- LPG) is a fuel widely used for agricultural purposes and for heating in rural areas and is pipelined when sufficient volumes make it economic. The other NGLs typically represent by-products from the production of crude and natural gas, petrochemical feedstocks and products and intermediate materials among gas plants associated with natural gas production, refineries and chemical plants. In low volumes NGLs are transported by truck and rail, but a pipeline network has developed in the larger production areas, such as East Texas and West Texas, along the Texas/Louisiana Gulf Coast with its concentration of gas plants, refineries and chemical plants and from Canada into Michigan. The demand for and availability of NGLs, associated with growth in Gulf of Mexico crude and natural gas production and growth in the petrochemical industry, provides an outlook for expanded NGL pipeline systems in the years ahead.

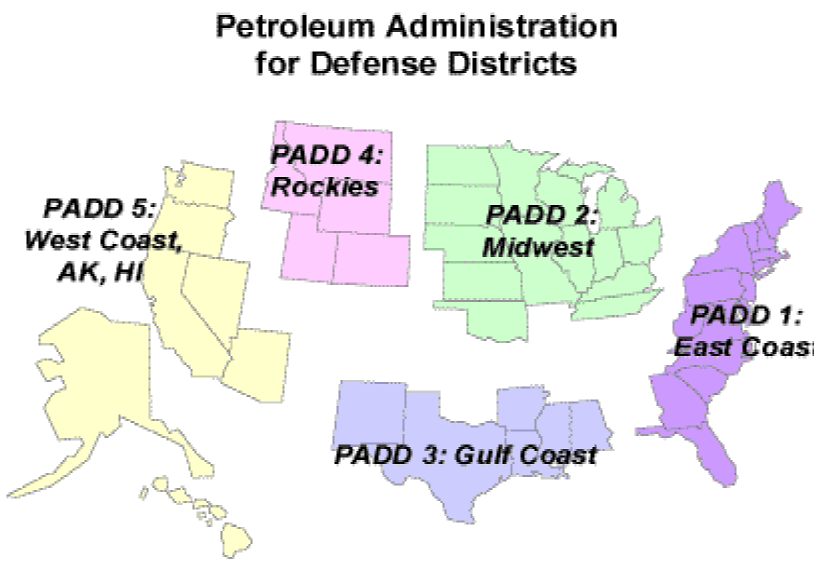
The situation with petrochemical feedstocks and products is similar to that of NGLs, although there are many materials moved by pipeline that do not fall under the umbrella of NGLs. For example, pipelines, particularly along the Texas/Louisiana Gulf Coast, transport ethylene, propylene (both in dilute and concentrated forms), butylenes, hexane, benzene, toluene, xylene, butadiene and many others, smaller streams. The petrochemical industry has grown rapidly during the last several decades and the outlook is for continued expansion as the overall economy grows. The need for liquid pipeline additions and expansions will grow concurrently.

There are other, miscellaneous materials carried by liquid pipeline companies, such as carbon dioxide (CO_2) and anhydrous ammonia, and non-liquid materials that are transported, such as nitrogen, oxygen, hydrogen and coal slurry. However, the circumstances that create the need for pipeline transportation are usually specific. Such situations will undoubtedly continue in the future and needs and opportunities will arise from time to time, but in the aggregate they represent a very small activity by the liquid pipeline industry.

Regional Considerations

Another dimension to an understanding of the needs for liquid pipelines is to take into account regional factors. Inasmuch as the government established a standard nomenclature for regional energy measurement and analysis during World War II that is still in use, it will be used here. Five Petroleum Administration for Defense Districts (or PADDs) were established, with PADD I covering the Atlantic Seaboard, PADD II encompassing the Mid-West, PADD III being along the Gulf Coast, PADD IV covering the Rocky Mountains and PADD V being along the West Coast, Alaska and Hawaii. Some PADDs are further subdivided, such as a north and south Atlantic, to better recognize regional differences.

Exhibit 9. Petroleum Administration for Defense Districts



Energy Information Administration/"Oil Market Basics."

Exhibit 10. Daily Supply and Disposition of Crude Oil and Petroleum Products, 2001

Thousand Barrels per Day

	PADD I	PADD II	PADD III	PADD IV	PADD V	TOTAL
Crude production	20	458	3,271	288	1,764	5,801
Crude imports, net	1,476	888	5,925	275	746	9,310
Crude, net receipts	3	1,998	-1,907	-94	0	0
Refinery input - crude	1,499	3,303	7,278	500	2,547	15,127
- total	1,877	3,386	7,795	532	2,791	16,381
Finished petroleum products						
Refinery production	1,922	3,439	7,833	544	2,880	16,681
Imports, net	1,061	5	-297	6	-108	667
Receipts, net	2,762	895	-3,815	53	104	0
Products supplied	5,721	4,526	3,753	598	2,883	17,481

Energy Information Administration/Petroleum Supply Annual 2001, Volume 1

Exhibit 11. Operational Parameters by PAD District, 2001

Thousand Barrels per Day

	PADD I		PADD II		PADD III		PADD IV		PADD V		TOTAL
Production	FL	12	OK	188	TX	1,162	WY	157	AK	963	
	PA	4	KS	93	LA	287	CO	45	CA	714	
	WV	3	ND	87	NM	186	MO	44	Fed offshore	85	
	Other	1	Other	90	Fed Offshore	1,536	UT	42	Other	2	
					Other	100					
Total		20		458		3,271		288		1,764	5,801
Refineries											
Number		16		27		56		16		38	153
Capacity		1,715		3,591		7,780		572		3,128	16,785
Refinery Crude Receipts											
Domestic		29		1,689		2,144		296		1,901	6,058
Foreign		1,472		1,613		5,104		205		744	9,139
Pipeline		68		3,287		3,016		468		1,022	7,860
Tanker		1,201		0		3,930		0		1,554	6,686
Barge		217		1		253		0		36	507
Tank cars		8		0		3		0		10	20
Trucks		7		14		47		33		23	124
Total		1,501		3,302		7,249		501		2,645	15,197

Energy Information Administration/Petroleum Supply Annual 2001, Volume 1

PADD I is located along the Atlantic seaboard.

While PADD I was the home of the early American crude production industry, its fields are largely depleted. For many years there has been virtually no indigenous production (20 thousand barrels per day in 2001) and there is little likelihood of developing any meaningful amount. As a result, its refining industry (16 refineries with 10% of US capacity), which is concentrated along the coast in Virginia, Pennsylvania and New Jersey, relied on domestic crude transported by tanker largely from Texas and Louisiana ports until US crude production reached capacity in 1970. Since then the refineries have lived on an increasingly larger diet of foreign crude (98% in 2001), directly imported from the North Sea, South America, Africa and the Middle East.

With its large population, the demand for petroleum products in PADD I (5.7 million barrels per day) exceeds its indigenous refinery production so products must be imported (4.2 million barrels per day), both from PADD III (Texas and Louisiana) and increasingly from foreign sources. From time to time, the possibility of adding a major increment of refining capacity has been studied, but the economics were never favorable. Among the factors were higher East Coast construction costs, higher landed crude costs (because the lack of a deep water port led to the use of smaller, more expensive tankers) and the lack of downstream infrastructure to deliver product from a central refining location.

The situation in the South Atlantic sub-region differs slightly in that its demand is rising faster than in the North and it relies to a greater extent on pipeline imports of products from PADD III. The outlook, especially in the Southeast, is for increasing product imports from both domestic and foreign sources as the region's population grows. The major pipeline systems carrying product from PADD III into PADD I are Colonial and Plantation for motor gasoline, diesel, jet and heating oil and Dixie for propane. A number of older, smaller pipeline systems internal to PADD I are used to carry products from coastal refineries and terminals to interior areas. Systems originating in Providence, Rhode Island; Northern New Jersey; and the Philadelphia/Paulsboro, NJ area are examples.

PADD II encompasses the Mid-West.

PADD II is comprised of a populous, highly industrialized eastern section and a more rural, agricultural western section. For a long time indigenous crude production, supplemented with domestic crude from the northern Rockies and from Texas and Oklahoma was sufficient to supply local refineries. Refined product demand was met through a combination of output from the local refineries and product imports, primarily from the south, some by barges up the Mississippi River and other by pipeline. In recent decades local crude production has diminished considerably (dropping to 600 thousand barrels per day in 2001) and West Texas and Oklahoma crude production is preferentially sent to PADD II. Imported crude has increased to feed increased refining capacity and to offset declines from other sources. During 2001 1.3 million barrels per day of domestic crude and 1.6 million barrels per day of foreign crude entered PADD II. A considerable portion of the imports originates in Western Canada, but lines such as Capline, which connects LOOP (Louisiana Offshore Oil Port) with the mid-west are an important source of crude. Depending upon short term supply and cost factors, the mix of imports swings between Canadian sources and crude that was tankered to the Gulf Coast. Inasmuch as refining capacity has remained relatively flat, with expansions off-setting shut-downs, the need to import domestic products has increased to meet growing demand, reaching 900 thousand barrels per day in 2001.

The liquid pipeline industry has responded to PADD II's needs by adding crude transmission capacity from Western Canada and from PADD III and product transmission capacity from PADD III. The overall crude carrying capacity exceeds PADD II's needs, and in recent years there have been periods when the systems from Canada and from the South have had significant spare capacity. The outlook is for a continuation of uncertainty in the mix of crude imports. As for products, a number of projects have been completed recently to move more products into PADD II from PADD III. The pace of those expansions and additions will depend upon the rate of product growth and whether there is any significant further curtailment of refining capacity within the region (27 refineries and 3.6 million barrels per day of capacity in 2001).

PADD III located along the Gulf Coast, is the US refining center.

During most of the twentieth century PADD III had sufficient crude production to meet the needs of the growing refining centers along the Texas/Louisiana Gulf Coast. After inland production reached maximum levels in the early 1970s, further growth in crude demand was supplied from foreign imports. With the decline of inland production and the shift to foreign crude it made sense to transport much of the remaining inland production to PADD II, mostly through Cushing, Oklahoma, and to increase foreign imports for the coastal refineries rather than to incur the cost of hauling that crude to the Mid-West. Another factor in the level of imports has been the amount of production in the Gulf of Mexico. Industry moved into coastal waters after World War II, but formerly sizable, near-shore volumes had declined significantly by the 1980s as fields were depleted. With advances in technology, exploration and production in deeper waters accelerated during the 1980s and 1990s and that substantial production (1.5 million barrels per day in 2001) has slowed the growth in crude imports. Because the product output of PADD III's refineries exceeds region demands there are essentially no product imports to the region and substantial product movements out of the region (3.8 million barrels per day in 2001), largely by pipeline, to the East Coast (PADD I) and the Mid-West (PADD II).

In view of the very large inland crude production in PADD III through much of the 20th century (3.3 million barrels per day in 2001), a crude pipeline system was established to transport that crude to the large coastal refining centers in Texas and Louisiana and to transport the excess to PADD II. As production declined and much of what remained went to the Mid-West, the need for the capacity decreased, forcing the abandonment of lines and encouraging attempts to convert the remaining capacity to other uses. There was a short-lived blip in the 1980s when some of the under-utilized capacity was used to move excess Alaska and California crudes east from PADD V. For instance, All American Pipeline was built for that purpose. However, with the decline of production in Alaska that movement ceased during the 1990s. The process of reducing the crude pipeline infrastructure in PADD III is continuing and is the source of many issues and uncertainties. These include questions about asset rationalization through sales to small, independent operators, the age of the lines, the impacts (environmental and other) of using the pipe for other purposes and the growing urbanization of many parts of the region. The situation regarding product pipelines is different, in that the demand for product movements into PADDs I and II continues to increase and thus it is a matter of continuing to add capacity in logical, cost-effective increments. The outlook is for that trend to continue.

PADD IV is located at the Rocky Mountains.

PADD IV, the Rocky Mountains, is a sparsely populated and not highly industrialized region. As such the local crude production (288 thousand barrels per day in 2001) has tended to be sufficient to feed the typically small refineries (16 refineries with less than 600 thousand barrels per day capacity) that are located to satisfy the widely distributed population. In recent years the decline in Wyoming crude and the demand growth, particularly in Billings, Montana-area refineries serving the Northern area, has been met by modest increases in the availability of Canadian crude. Growth in Colorado has largely been met by small increases in local refining capacity and increased movement of refined products from the South (PADD III).

Given the scope of crude and product movements within PADD IV the pipelines are of modest size and the systems have been changing less than in the other PADDs, although there have been a number of recent ownership changes. An exception has been the addition and expansion of crude transmission pipelines passing through the northern part of PADD IV that carry crude from Western Canada to the Mid-West. While the changes taking place in PADD IV are modest in relation to those in other regions, the increasing availability of Canadian crude and the specter of product imports from the South is a major concern to local industry participants, especially in the Salt Lake City and Casper, Wyoming areas. One manifestation of the competitive situation is the relatively large number of cases brought to the FERC involving PADD IV pipeline transportation.

PADD V is located along the West Coast, Alaska and Hawaii.

The rapid and large population increases, the dependence on the automobile and the advent of stringent environmental regulations have had a major impact on PADD V, particularly in California. PADD V has long been home to crude production in and around Los Angeles, in State waters towards Santa Barbara and to production of heavy crude from large fields in the San Joaquin Valley between Los Angeles and San Francisco. In the late 1960s there were substantial finds of heavy, high sulfur crude in federal waters off Santa Barbara and of the giant Prudhoe Bay field on the North Slope of Alaska. Through the first half of the century local production had been sufficient to meet refining needs, but as demand for products outstripped domestic crude availability foreign crude imports increased to fill expanding refining capacity. With the advent of production in Alaska and the Outer Continental Shelf (OCS) imports were largely eliminated and refining capacity was added in the Pacific Northwest. That capacity was supplied with Alaska crude and the excess PADD V crude was transported to PADDs III and I via a logistics system combining marine and pipeline segments. By the year 2000 Alaska production had declined to one million barrels per day (versus a peak of 2.1 million barrels per day in 1988) and OCS production had declined substantially as well (85 thousand barrels per day in 2001). Thus, the movements to PADDs III and I ceased and foreign imports resumed. The high intensity refineries on the West Coast (38 refineries with 3.1 million barrels per day capacity in 2001) and some product imports have largely met the demands for refined products (2.9 million barrels per day in 2001), which are weighted much more heavily to motor gasoline than elsewhere in the US. From time to time there have also been marine movements of product to PADD V, usually from PADD III. Those movements, which transit the Panama Canal in purpose-built ships, are only economic during periods of price disruption.

Since early in the 20th century there has been a network of crude pipelines in place in California. For the most part, they have been private, proprietary lines, unlike the common carrier systems in the rest of the US. As refineries expanded and new ones were added and as production grew the pipeline network expanded to meet the growing transportation requirements. A relatively recent example was the construction of the common carrier intra-state Pacific Pipeline to move increased San Joaquin Valley (Bakersfield) production to Los Angeles area refineries.

The discovery of oil at Prudhoe Bay in 1969 necessitated creation of a large, expensive and rather unique transportation system comprised of the 800 mile, 48" diameter pipeline from Alaska's North Slope to a marine terminal at Valdez, Alaska. From there large tankers transport the crude to refineries, primarily in areas near Seattle, San Francisco and Los Angeles. During the years when the supply exceeded PADD V demand, the excess crude was transported to PADDs III and I. Initially the excess moved by tanker around South America, later a pipeline was constructed across Panama enabling tanker-pipeline-tanker movements and still later a pipeline was built from the San Joaquin Valley to West Texas where it connected to the existing pipeline infrastructure enabling Alaska and OCS crude to reach the Houston area.

The refined products market in PADD V has historically operated independently of the markets elsewhere in the US. Distance and terrain were certainly factors, but generally adequate refining capacity, a proportionally greater demand for motor fuels and mandates for special grades of gasoline during recent decades have combined to discourage pipeline interconnections between PADDs III and IV and PADD V. Normally, the network of pipelines that has developed to move refined products to distribution terminals for dissemination to the ultimate consumer is adequate to meet West Coast needs. However, the supply/demand balance is fairly tight and the infrastructure provides only limited flexibility to accommodate short-term issues. Thus, if a few refineries encounter operating problems, if there is a problem in the distribution system (pipeline or other) or if prevailing prices jump, there is no quick mechanism for the energy industry to respond. The events in Phoenix during the summer of 2003 (i.e. price run-up and service station lines as a result of a pipeline outage) illustrate the impact of an infrastructure problem on supply and price. A few attempts have been made to add infrastructure, such as the Longhorn proposal (conversion/reversal of a former crude oil trunk line to refined products service) that could move Gulf Coast product to California in conjunction with Kinder Morgan's SFPP system, but economics, competitors and various local interests have stymied a solution.

Competition with other Transportation Modes

While liquids pipelines are the primary workhorse for transporting crude oil and refined petroleum products, tankers, barges, railroads and trucks are an important and, in some instances, an essential element of the transportation system. In almost all cases the selection of a transportation mode is an economic choice, but there are factors that swing the economics to favor one or another alternative.

The most obvious examples are that imports of crude and products, other than overland from Canada and Mexico, must move by tanker, whereas many locations cannot be reached by either tankers or barges. Probably the most significant factors in determining the optimum transportation mode relate to the number and location of the sources and destinations of the crude and products to be moved and the volumes (both average and extremes) among the sources and destinations. At one end of the range, pipelines, because they are capital intensive and not very flexible, are best suited for high volumes moving from a limited number of sources to a limited number of destinations. At the other end of the spectrum, trucks are extremely flexible and can extend the range of less flexible transportation modes. Trucks do not impose a large capital requirement, at least for low volume movements, but are expensive to operate. Railroads, barges and coastal tankers fall between the two extremes.

Until the rapid increase in crude imports in the 1970s, tanker transportation had been utilized to move PADD III crude to PADD I, to haul modest amounts of specialized foreign crude imports (such as Venezuelan asphalt crude) and for the coastal movement of petroleum products. Since then tankers have played a key role in the system for moving Alaska crude to lower-48 refineries and for importing foreign crude, while the previous uses have diminished or ceased.

There is a modest utilization of barges to move crude and a much larger utilization to move products in coastal service and on the major river systems. During recent years the role of barges, particularly on the river systems, although still significant, has been declining in response to environmental and safety concerns and to other operating issues, such as winter icing, low water limitations, flood situations and the expansion of other transportation alternatives. However, some areas, such as New England and southern Florida, remain dependent on coastal tankers and barges to transport products.

Short hauls and small-volume point-to-point movements clearly favor the use of trucks, especially when many sources or many destinations are involved. Thus, the movements of products to the consumers from distribution terminals are almost exclusively handled by trucks. It is a common sight to see trucks delivering motor gasoline to service stations, heating oil and propane to residential and commercial customers and aviation fuels to fixed base operators. Also, trucks are a strong competitor of pipelines for gathering crude, especially as fields are depleted and production declines, as well as for occasional, low-volume movements of miscellaneous crude and petroleum products.

Railroads tend to serve niche opportunities for moving crude and products. For example, there is a unit train operation in California moving heavy San Joaquin Valley crude to a refinery in the Los Angeles area and there is a unit train operating as part of the Yellowstone product system in Montana. In addition there are numerous movements among gas plants, refineries and petrochemical plants of feed stocks and intermediate products as a result of low and variable (sometimes seasonal) volumes.

Ownership Structure of the Pipeline Industry

The needs for liquid pipelines are diverse and so are the ways in which the industry is structured to meet those needs. Pipelines may be independent entities or may be owned, in whole or part, by integrated energy companies, by other companies in or out of the energy industry and by investors. In many instances they are owned jointly by a combination of entities. A particular pipeline may be organized as a stock corporation, a partnership, a particular form of partnership known as a Master Limited Partnership (MLP) or as a Limited Liability Company (LLC). Furthermore, the owner may not be the operator of a pipeline. While it is most common for an owner or one of the owners, in the case of a joint venture, to act as the operator, there are instances when an independent, third party operates the line on behalf of the owner(s). The way in which a pipeline is owned and structured is a function of many factors, including the purpose of the pipeline, the complexity of the task, historical considerations, legislative and regulatory constraints, the ability to raise capital and a necessity to manage a wide variety of risks.

The way a pipeline company is structured must consider the purpose of the system. In its simplest form a pipeline may move a single material from one source to one destination over a distance as short as a mile or less, or as long as a thousand or more miles, and it might operate in a single state or cross numerous state boundaries, or it might be located in federal waters and not in any state. Examples include lines carrying crude oil from one production platform to another in the Gulf of Mexico, crude oil from one marine terminal to one refinery, jet fuel from one refinery or terminal to one airport, fuel oil from one terminal to one power plant or petrochemicals from one plant to another. Beyond those simplest forms the complexity can become considerable. There can be many sources and a single destination (such as crude gathering), a single source and many destination (such as a products line serving a single refinery and a number of end markets) and networks that include many sources and many destinations. And whatever the physical layout of the pipeline, it may carry a single product or many discrete products/grades and it may carry material for one or for many shippers.

The role of Integrated Companies

In the early years of the petroleum industry most pipelines were part of integrated companies, whether established by a crude producer needing to transport its crude to a market or by a refiner needing a reliable supply of feedstock for its refinery. But as the energy industry has grown and diversified, as new entrants have been established and as special situations have arisen the extent of integrated ownership has diminished to the point that only about one-third of liquid pipelines are part of integrated enterprises today. Along the way independent companies have been established whose sole business is pipeline transportation and related services. Also, other interests such as pension funds, private investors (individually or collectively in funds) and corporations in other businesses, such as electric utilities needing fuel for their power plants, have assumed ownership of pipelines. The effect of integrated ownership has also diminished greatly during the last ten to twenty years as financial and other pressures have caused the remaining integrated energy companies to demand that every segment of their company stand on its own. Thus, the pipelines owned by integrated companies look to third party business as essential to their well-being and the integrated owner ships on whatever pipeline will provide the best service at the best price.

Joint Ownership

Joint ownership of pipelines is increasingly common as a means to manage business risks, to achieve economies of scale, to obtain sufficient capital for large, risky projects and to enhance the ability to establish new pipelines in the face of increasing difficulties in obtaining permits and other approvals. The way in which joint ownership is implemented takes many forms, both as to the structure of the venture and as to its management.

Joint Venture

Undivided Joint Interests

A joint venture (JV) may look similar to a non-JV (i.e. a corporation, partnership, MLP or LLC), but have multiple owners and be managed as though it were a single entity. Alternatively, it could be organized as an Undivided Joint Interest (UJI) in which the owners act together to build, operate and maintain the pipeline, but each owner retains responsibility for its share of the common facility, performing activities such as posting separate tariffs, handling its own revenue accounting and so forth. A UJI has been described as multiple straws, each owned by a different party, within a single, larger straw. A well known example of a UJI is TAPS (the Trans Alaska Pipeline System). In that case five owners -- BP, ConocoPhillips, ExxonMobil, Unocal and Koch -- own varying shares, post their own tariffs and compete for shippers, but together have a contract with Alyeska Pipeline Service Company to operate the line for their mutual benefit. By agreement there is an Owners Committee to resolve any conflicts in operating instructions to the contract operator. JVs also can be managed directly by employees of the venture (as is case for Colonial and Explorer) or by one owner serving as the operator under contract to the JV (examples of which include Plantation, Yellowstone, West Shore and Wolverine). In the latter situation it is usual that the ownership agreement provide a mechanism for the operator to resign and for the owners to replace an operator.

Stock Corporation

During much of the twentieth century the most common form of structuring a pipeline venture, whether singly or multiply owned, was a stock corporation. Such entities are straight forward with the owner(s) holding the stock of the venture, but the entity raises capital itself to build facilities, receives revenues for its services, incurs costs to operate, pays taxes and provides dividends to its owners to the extent it is profitable.

Partnerships, Limited Partnerships

Along the way partnerships began to be utilized as a means to minimize tax liability, but they carried the risk that every partner assumed the business liabilities of the pipeline. As states allowed the creation of limited partnerships, that form came into use as a means of shielding the limited partners from the business liabilities and concentrating those risks with a managing general partner who typically owned only a small fraction (say 1%) of the venture. During the last ten years or so, states have allowed the creation of Limited Liability Companies (LLCs) to allow taxation benefits and liability protections in an entity that resembles a corporation. Although only recently available the LLC form is gaining wide usage.

Limited Liability Companies

Master Limited Partnerships

Master Limited Partnerships (MLPs) are a variation of the partnership form that was created by the 1986 Tax Reform Act and are limited to the development, production and transportation of natural resources. In addition to the tax and liability benefits of limited partnerships, MLPs have great utility for raising capital because units (e.g. the analog of corporate shares) trade on stock exchanges and are generally available to public investors, large and small. The use of MLPs has increased rapidly during the past 15 years and can be expected to increase further. Even large, diversified energy companies such as Sun and Williams reorganized their pipelines into MLPs. Other examples of MLPs are Buckeye, Kaneb, TEPPCO, Kinder Morgan, Plains All American and Enterprise.

Mergers, Acquisitions, and divestments are changing the ownership structure of the pipeline industry.

The owner and the operator of a pipeline need not be the same entity although it is most common for an owner to serve as the operator. That is especially true when there is a single owner, but less so for a joint venture. The operating entity has the day-to-day responsibility to control, monitor and maintain the pipeline. In addition there are many responsibilities of the operator relating to reporting, regulatory compliance, community interfaces and emergency response. There are several reasons for an owner to contract with a third party to operate its pipeline. The most common ones involve joint ventures where no owner wishes to accept total liability given their partial ownership or where the owners do not want one owner to serve as operator and thereby receive any perceived advantages. Other reasons for using a contract operator include insufficient operating capability within the owner organization and attempts to achieve economies of scale by utilizing an entity with other operations.

The structure of the US pipeline industry has been changing significantly in recent years as mergers, acquisitions, divestments and other transactions have occurred. The reasons for the changes go beyond evolving corporate forms and changes in the transportation needs of the industry's customers. Rather the drivers have been the need to manage costs, the desire to achieve economies of scale and to reduce a wide variety of business risks, the necessity of complying with regulatory requirements and the hope of realizing new business opportunities. Several examples are cited in the following paragraphs.

As throughputs have declined in inland crude gathering systems and in certain crude transmission pipelines, the owners of those systems and lines have attempted to find new customers to replace the declining business. When that has not been successful they have merged with competing systems to establish a viable successor, have sold to an existing player or to a new entrant, have sold or transferred the asset to a new entity to be used for some other purpose or, as a last resort, have shut down and abandoned the facilities.

The approval of many large corporate mergers has been conditioned by the FTC and the states on divestiture of ownership in one or more pipelines, such as Mobil's interests in Colonial and TAPS and Shell's interest in Plantation.

The advent of MLPs has provided the capital to acquire existing assets with a goal of improving profitability and providing an attractive return to a wide ownership population. As a result, MLPs' share of pipeline assets has grown significantly, through acquisition and by reorganizing pipelines into MLPs. Shifts in the transportation business, combined with needs to reallocate capital among competing uses and changing assessments of the risks associated with pipeline transportation have led companies to divest assets that are no longer viewed as core to their business and where it is assessed that the asset may be worth more to someone else than to the existing owner.

The changes in the pipeline industry are increasing the level of competition and spurring efficiency improvements. Those changes are encouraging and likely to continue, but there are issues that flow from them. For the most part they relate to a diminishing role for the well established, well financed and larger organizations that have been the back bone of the industry for a century. In their place are new entrants that need to establish their positions and build the organizations and capabilities.

Operational Factors

Operational Integrity

Safe, environmentally sound and reliable operations, variously called Operations Integrity or Operational Excellence, is absolutely critical to the liquid pipeline industry. Throughout its history the industry has worked at making its operations safer for its employees and its neighbors and more environmentally friendly. And the long term trends show progress and demonstrate that pipelines are the safest means of moving petroleum. Despite that progress, there have been safety and environmental incidents and the industry's stakeholders have not been satisfied with the rate of improvement. In recognition that operations can and must be improved more rapidly the leadership of the pipeline industry has put in place voluntary initiatives to accelerate the pace. The objective is to strive to eliminate all incidents. That will be extremely challenging, and may never be fully realized, but industry-wide data covering the past few years demonstrate a step-change in the rate of progress.

Operational integrity: a focus on safety, environmental protection and reliable throughput.

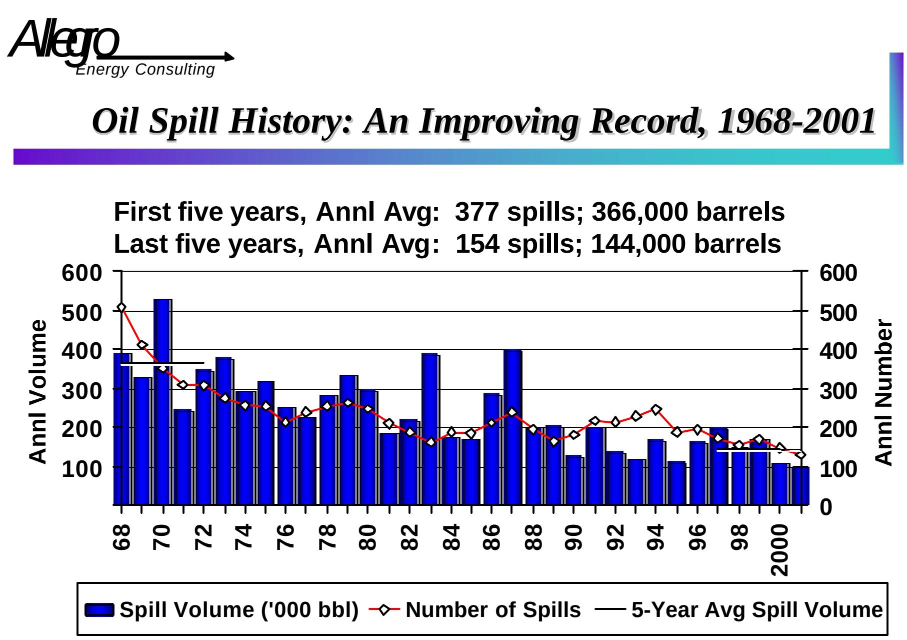
The key to achieving fundamental, long-term, sustainable improvements in operations integrity is to employ sound management systems that span the full spectrum of the design, construction, operation and maintenance of pipelines. It is essential that those systems be clear, understandable and practicable so that everyone having a role in their implementation knows the objectives of the system, what resources are available, who is responsible for performing the various activities, how performance will be measured to assure the objectives are being met and how the process can be improved as time passes, lessons are learned and technology improves. The coverage must be broad, including employees and contractors alike, extending from the most junior employee to the most senior manager and covering the processes that directly relate to operations and maintenance, the supporting ones, such as procurement, record keeping and human resources, as well as those associated with planning, risk assessment and risk mitigation. During the past dozen years or so, a number of management systems have been developed to achieve operations integrity. The systems go by many names and have minor variations, but they contain the same fundamentals. Many companies voluntarily have adopted one or another system and even those that have not done so are employing many of the features of the approach since an increasing number of regulatory requirements mandate such systems, at least in some areas of operations and maintenance.

Measurement is an essential element of management systems. For a long time most pipeline companies have measured various operational parameters and the federal and state regulatory bodies with jurisdiction over the industry have mandated certain reporting requirements. Historically, there were gaps and inconsistencies in what was measured and reported and the thresholds for reporting were sometimes high relative to the performance that the industry and the public expected. For example, until the beginning of 2002 the Office of Pipeline Safety (OPS) had an incident reporting threshold of 50 barrels spilled unless damage exceeded $50,000 or there was an injury, fatality, fire or explosion.

Pipeline Performance Tracking System

The liquid pipeline industry initiated a voluntary program effective January 1, 1999 to gather data on spills of any amount to water and other spills greater than 5 gallons. There were concerns as to what the data would show and how it might be misused to the disadvantage of the industry. Nonetheless, two-thirds of the industry participated. As with any new initiative it took a few data gathering cycles to clarify definitions, to standardize forms and to get the process working smoothly. Although the data are not publicly available, OPS has kept abreast of developments and used the industry experience to enhance its reporting systems effective in early 2002.

Exhibit 12



Source: RSPA 7000-1

Since 1968, the year that data collection began, the spill record of the liquid pipeline industry has improved substantially, with the amount of oil spilled decreasing about 60%. During the five years 1968 to 1972 the industry averaged 377 incidents reportable to OPS per year and an annual spill volume of 366 thousand barrels. During the most recent five year period (1997 to 2001), the number of reportable average annual incidents dropped to 154 and the spill volume declined to 144 thousand barrels annually. The improvement continues as 2000 was a record low year and 2001 surpassed that (128 incidents, 97 thousand barrels). The available data show that pipelines have a better safety record than other modes of transportation and that outside force damage was the most important cause of large spills. Internal and external corrosion were a major cause of smaller spills, often on pipeline company property. All spill causes are being vigorously pursued to further improve performance.

Security

Post-September 11 security concerns are a top priority.

The tragic events of September 11, 2001 triggered a re-examination of the security of the oil pipeline network, which is the core of the US petroleum transportation system. As such, it is a valuable national asset that must be protected. Fortunately pipelines are physically robust with the vast majority of the system underground and less vulnerable than aboveground facilities. And pipeline operators have been managing the integrity, safety and security of their systems for many years. The historical efforts have been enhanced (1) by ready cooperation with the federal government to identify, for preparedness purposes, those pipeline facilities that are critical to the nation; (2) by cooperatively developing security guidance ("Guidelines for Developing and Implementing Security Plans for Petroleum Pipelines" --- API. July 2002); and (3) by responding to the federal government's guidance for security contingency planning.

By April 1, 2003 operators of 95% of the oil pipeline infrastructure had certified to the US Department of Transportation their compliance with the contingency planning guidelines. Shortly thereafter the Office of Pipeline Safety began to conduct verification checks to validate the certifications. In addition, pipeline operators are conducting and will continue to conduct vulnerability assessments of critical pipeline facilities as the federal government and the industry develop a better understanding of the terrorist threats and capabilities. Operators have taken numerous steps, in many forms to enhance security and will continue to work closely with the Office of Pipeline Safety and the Department of Homeland Security to take prudent and practical actions, including monitoring threat information, analyzing pipeline vulnerabilities and implementing practical and reasonable protective measures.

Rights-of-Way

Rights- of-Way are a critical feature of planning, operating and maintaining the pipelines.

Pipelines physically reside in Rights of Way, which are sometimes owned by the pipeline owner, but more often are used under the terms of an agreement with a private landowner or a permit from a public landholder. During the early years of the industry, obtaining rights of way was relatively straightforward and the agreements tended to be simple documents. As the industry has matured the issues associated with rights of way have multiplied and there are many examples of contentious, emotional and protracted battles stemming from attempts to acquire new rights of way or to utilize existing ones. The outlook is for the situation to grow ever more difficult, given the increasing urbanization of the US, heightening concerns about environmental and safety matters, an increasing goal of extracting monetary value for use of the land and a growing unwillingness to site industrial type facilities in many areas.

Today, a well-written pipeline agreement or permit will address many terms, starting with a description of the physical easement, including its width. Other items include duration, renewal, fees, rights of the pipeline company to access the easement and rights of the landowner, restrictions on use of the easement by both parties, the number and size of lines, materials that may be transported, rights for expansion (number of lines, size of lines), communications among parties, abandonment (definition and responsibilities), and more. Older agreements often did not contemplate many of the issues and, as one or another situation has arisen, have resulted in expensive, time-consuming arguments and frequently in litigation. Modern agreements that deal with the range of terms and conditions and more clearly spell out the restrictions on the parties tend to raise the right of way cost.

Acquiring a Right of Way

A liquid pipeline desiring to invest in a new line has a number of options for acquiring a right of way. Whichever approach is pursued, an analysis of the alternative routes and the issues associated with each is the starting point. Once a lead route has been selected the pipeline has the option of buying the right of way in fee, in which case the company would become the landowner and maintain full control. That could be expensive and often impossible. Alternatively the pipeline can approach the landowners along the proposed right of way and negotiate voluntary agreements for easements. If that fails, and the proposed pipeline will be a common carrier, the pipeline company may be able to resort to using its right of eminent domain that is spelled out in the statutes of the particular state. Increasingly, using rights of eminent domain leads to time consuming and expensive litigation, but often the project may move forward before all of the cost issues are resolved. In view of the difficulty and expense of acquiring rights of way there are examples in highly developed areas, such as Houston, of pipeline corridors being established and set aside for future construction of lines. The initiative may originate with a pipeline company or it may be promoted by a local jurisdiction.

This discussion has focused on private landowners, but the permitting process for the use of public lands has many similar features. Under certain circumstances, both public and private, it may be necessary to conduct an environmental impact review, assessment or study as spelled out under NEPA (National Environmental Policy Act of 1969) which adds complexity, time and cost to the process.

Both for existing and new rights of way there are continuing responsibilities to maintain the rights of way and to comply with the provisions of the agreements. Operations and maintenance require keeping the easement clear (periodic mowing, side trimming of trees, etc.) inspecting it with some frequency (surveillance flights, traversing the route, etc.), inspecting and maintaining the line and any associated facilities, such as cathodic protection, valves and meters, and dealing with any encroachments that may occur. When restrictions in the agreements on use of the easement by the landowner have not been rigorously enforced it may become necessary to remove structures (i.e. buildings, sheds, fences, etc.). That can create considerable animosity between the pipeline and the landowner.

As the pipeline industry strives to reduce operational incidents, increasing attention has been focused on rights of way. Historical analyses show that the leading cause of the more severe incidents have been impacts sustained by the pipe, whether caused by the landowner or by someone, such as a utility company or contractor, operating on behalf of the landowner. Thus, ever more stringent processes, such as emphasis on a "call before you dig" process and increased surveillance, are being employed. Furthermore, in the event of an incident, no matter the cause, the safety of neighbors increases the further from the pipeline they are located. Thus, some initiatives associated with land use restrictions are beginning to establish minimum setbacks from pipelines. In a more urbanized environment these may be needed, but they raise issues of conflicting land use and can be contentious.

Capacity Management

Historically there has been sufficient pipeline capacity in the US to meet shippers' needs, whether for moving crude oil to market, providing feedstock to refineries and petrochemical plants or transporting products from those refineries and plants to consumers. However, from time to time, situations arise, such as the start-up of new facilities (e.g. a new production field or a new refinery), growth in aggregate demand, and short-term perturbations or emergencies (e.g. weather, pipeline outages, other supply disruptions) that call for steps to increase capacity. These are becoming more frequent, especially in some geographic areas such as the Mid-West and West Coast.

In many cases there are steps that can be taken to squeeze more capacity out of an existing system. Examples include raising the operating pressure on a line when it is safe to do so by adding or modifying the existing pumps, by adjusting the schedule for moving multiple products on a particular line to take advantage of the specific configuration of the line and its related facilities, by reducing down-time through improvements in operations and maintenance practices and by employing relatively new technology, such as Drag Reducing Agent (DRA) that reduces friction in the pipe, thereby allowing a higher rate of flow. If such steps are insufficient, presumably there are business opportunities for one or another company to expand existing capacity or to add new capacity. It is always possible to build a new, large pipeline, but sometimes there are less costly opportunities, such as utilizing a line that had previously been in some other service and converting it to meet the new need, or swapping two lines to better match the physical capacity of the pipes with the needs of the respective shippers or removing local bottlenecks if most of the route would have sufficient capacity to meet the new situation.

Prorationing and capacity enhancement

During periods when there is insufficient capacity to meet the transportation needs of all shippers, established pipelines rely on provisions in their tariffs to prorate the available capacity among their shippers. Typically the existing capacity is shared in a way that reflects the historical pattern of shipments by the different shippers as well as their current needs and provides some consideration for new shippers not having an historical base. Usually a pipeline company will do everything possible to maximize the capacity available in the short term to avoid having to prorate capacity and to minimize the length of time prorationing is in effect. Available steps include deferring scheduled maintenance if the risks of doing so are reasonable, temporarily running spare equipment or running it harder, and increasing temporary staffing to expedite other short-term opportunities. Such steps apply in many situations, but depending upon the specifics there may be other opportunities that apply during supply disruptions. For example, if the problem is associated with a pipeline outage there are usually steps that can be taken to expedite the repair and the return of the facility to service. Needless to say, in any of these situations, good communications, coordination and cooperation among all of the interested parties and non-discriminatory solutions are essential.

Maintaining Product Quality

In the early years of the liquid pipeline industry the product quality emphasis was on avoiding any gross contamination of the material being transported. By the middle part of the twentieth century advances in the internal combustion engines for automobiles and the increasing use of airplanes raised the importance of maintaining product quality, especially in some of the grades being shipped. Higher-octane gasoline, aviation gasoline and later kerosene-type jet fuel required considerable care to avoid contamination. Then, in the years after World War II, the proliferation of special fuels, driven primarily by efforts to improve the environment, and the need to segregate some refinery and petrochemical plant feedstocks and intermediate products increased the challenge of maintaining product quality.

Crude Oils and quality banks

In the early part of the 20th Century there was little distinction among the various crude oils. As the sources of crude diversified, so did the characteristics of the oil. Early on some crude oils were good sources of lubricants and others were light and sweet (i.e. low sulfur) and used to make a variety of fuel products. As production expanded westward, crude oils were produced that had large variations in sulfur, metals content and density (called gravity) and occasionally in some other characteristic. Since higher sulfur, heavier crude oils generally had a lower value, commingling different types of crude oils in a pipeline carried an economic penalty to some shippers. One solution to preserve the relative value of the crude oils being transported is to maintain segregations by crude oil type, but that takes more facilities and pipeline capacity, raises the transportation cost and is not always practical. Another approach is to impose a quality bank, whereby the shipper of the poorer quality crude pays some money into the quality bank and the shipper of the higher quality crude receives a payment to compensate for the degradation of its crude. Typically the pipeline establishes the quality bank in its tariff, handles the accounting and uses some simple measure, such as sulfur level or gravity level alone or in combination, as the basis for the payments and withdrawals. In these situations the pipeline operator is merely the banker or escrow agent for the shippers of the differing crude qualities.

Feedstock to NGL fractionators and petrochemical plants

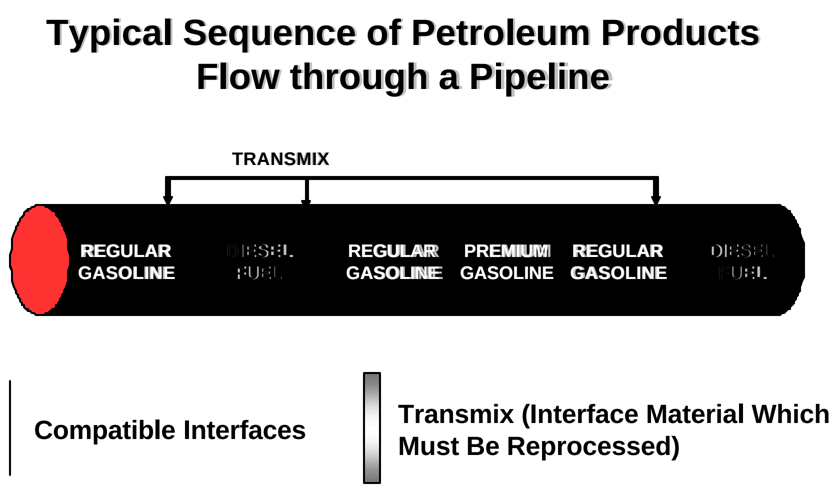
Although the quantities involved are considerably smaller, feedstock to NGL fractionators and petrochemical plants face analogous issues and solutions to those faced by crude oil. Because there will be further processing after transporting the raw materials there is a costly option of segregating the feeds or of commingling feeds whose quality varies and imposing a quality bank to compensate the shippers for the quality gained and lost during shipment.

Products and batching segregation

Products, whether from refineries or petrochemical plants, must have their characteristics maintained and cannot be commingled as is frequently done with crude oil. An exception is that a transmission pipeline may establish specifications for a fungible material, say regular gasoline, and batches from more than one shipper may be consolidated into a single fungible batch to be moved so long as the tendered material meets the minimum specifications. Commingling of fungible product thereby lowers the cost of transportation. In a few cases the volumes being transported are large enough, the distances are short enough or the specifications are so rigorous that dedicated lines can or must be used, usually at a significant cost. Fortunately, in most instances it is possible to batch the products, that is to say, carry multiple products in series in a single pipeline. Doing so requires additional facilities, which may include tanks, pumps, meters and analyzers, at the origin, destination and possibly at intermediate points. Close attention to scheduling the batches and good communications among the carrier and the shippers are essential. Good pipeline operations will minimize the mixing between successive batches. Depending upon the specifications of adjacent batches it may be possible to downgrade the interface between two batches into a succeeding lower quality material (such as premium gasoline into regular gasoline), but in other cases it will be necessary to segregate the interface, called transmix, and to arrange for it to be reprocessed.

Maintaining the integrity of the quality of product being shipped, whether it moves in batches or in dedicated systems, can be influenced by many operational factors. Facilities must be maintained to avoid leaks across closed valves where different materials are in the lines on either side of the valve. Care must be taken in operations to establish the proper interconnections (i.e. lineups) within tank farms and terminals when moving products in and out of tankage, to be sure that other or off-spec materials, such as water and transmix, do not enter a batch of good material. Quality is maintained by proper sampling and analysis (in a product quality laboratory or via an in-line analyzer) at various points in the transportation system. In some cases the product quality requirements are so stringent that the only way to assure their integrity is to isolate the system from all other materials.

Exhibit 13



Field Operations

Good field operations, which are critical to the safe, environmentally sound and reliable operation of a pipeline system and which may have significant impacts on maintaining product quality and operating cost, cover a wide range of activities. For reasons of brevity the discussion will be limited to a few areas, including gauging and calibration, equipment and facility maintenance, inspection and surveillance and emergency preparation.

Measurement

Measurement of the material in the custody of a pipeline company, whether in the process of being transported or in a tank awaiting further action, is important to the carrier and to its shippers, both for commercial and operational reasons, such as remote and automatic leak detection. Installing, maintaining and calibrating appropriate flow meters and tank gauges are essential and require regular activities. Usually tanks can be gauged remotely, but it is customary for field personnel to manually gauge tanks at least once a month. In-line flow meters can often be read remotely, but it is common to require that meters be read manually as often as daily and sometimes for individual batches which may require multiple readings a day. Calibrating (or proving) meters can sometimes be done automatically for high volume situations, but more often there is a schedule based on throughput and the necessity to make temporary connections of a portable prover.

Maintenance

Equipment and facility maintenance involves routinely inspecting and checking equipment, conducting scheduled activities to prevent failures and unplanned shutdowns and making repairs after inspections and breakdowns. Activities include using scraper pigs to remove the buildup of paraffin on the inside of crude pipelines, lubricating pumps, valves and other equipment; periodically running equipment that would otherwise be idle; and using cathodic protection, paint systems and other coatings to protect facilities. Normally there is a large amount of electrical gear associated with pipeline operations that must be routinely inspected and maintained and an increasing utilization of electronics that requires routine maintenance, upgrading and trouble-shooting.

Surveillance

Field surveillance of a pipeline covers a range of activities, conducted with different frequencies, to assure the integrity of the operation and to identify steps to prevent future failures. A common type of surveillance, aerial patrols every few days or weeks, is designed to spot leaks, encroachments on the right of way or activities off the right of way that have potential to impact the pipeline. Normally the pilot has a means to communicate with ground personnel so prompt action may be taken if the situation requires a quick response. Other types of surveillance, typically conducted less frequently, include personnel walking or riding along the right of way to gain an up-close view of conditions on the ground and the equipment, close interval surveys to ascertain the effectiveness of the cathodic protection system and inspections of waterway crossings, whether the crossing is by a pipeline bridge or a pipe laying on the bottom of the waterway or buried beneath the bottom of the water.

Preparations for emergencies

Preparation for emergencies includes maintaining and testing equipment used to recognize and deal with unexpected and undesirable situations and conducting drills to familiarize field personnel with response plans and their roles in promptly and effectively dealing with emergency situations. Equipment for monitoring the pipeline and ancillary facilities include sensors to spot high temperatures and pressures, flames, releases of hydrocarbon vapors, high levels in tanks and imbalances between the volume of material entering a line and that leaving the line. Other equipment is in place to shutdown and isolate sections of the pipeline, terminals or tank farms, under local or remote control or automatically. Drills are organized to rehearse steps that would be taken in response to oil spills or to other emergency situations. They frequently involve representatives from federal, state and local response organizations, and may be table-top exercises remote from the pipeline or field exercises that include the deployment of people and equipment.

Work Force

Duties and structure vary

As with any business, pipeline companies are organized to provide specific services to their customers and to provide the range of activities needed to support their mission. Mission-specific tasks include designing and constructing facilities, handling right-of-way matters, operating and maintaining the pipelines and ancillary equipment, interfacing with the pertinent regulatory bodies and conducting commercial activities, such as establishing tariffs and interacting with shippers. The support activities cover a wide range of tasks, including technical, accounting and legal support, planning analysis and reporting, human resources and general management. Depending on the size, complexity and philosophy of the company, the ways in which the organization is structured and staffed vary widely. Some organizations are centralized and others distributed, some rely heavily on employees while others out-source many activities, using a high proportion of contractors, and some are leaner than others in the level of internal staffing.

Pipelines have moved from manual to remote operations

The way in which pipelines are operated and maintained has evolved considerably over time. In the early years of the industry operations were largely manual and there was a need for local oversight and control, so the operations work force was distributed throughout the pipeline network. Typical field organizations were structured along craft lines, such as with guagers and operators in operations and with gangs, mechanics, electricians, instrument technicians and such in maintenance. With advances in technology, especially telecommunications, computing and remote sensing and control, it is possible to “operate” (i.e. “control”) most pipeline networks, even those covering facilities across the United States, from a single control center that can be located virtually anywhere. Those controllers are usually located in rooms filled with sophisticated consoles containing computer screens, TV monitors, and the latest in communications technology and employing state of the art SCADA (Supervisory Control and Data Acquisition) systems that enable the computers and the controllers to monitor and remotely control facilities (i.e. start and stop pumps, open and close valves and check operating conditions) regardless of the location of those facilities.

Maintenance

In some ways the maintenance activities have not changed so much as operations, but increased mechanization has somewhat diminished the traditionally manual activities, while the equipment and instrumentation (i.e. pumps, motors, valves, analyzers, sensors and local controllers) have become much more sophisticated and hence require a higher skill set to maintain. Recognition of the technological advances in operations and maintenance, together with the advent and emphasis on integrity management systems, caused many pipeline companies to take steps to enhance work force training and development, to raise performance standards and to periodically assess the qualifications of the relevant workers. Those initiatives recently became industry-wide and mandatory with the adoption by the Office of Pipeline Safety of the Operation Qualification (OQ) rule that is being implemented nation-wide.

Contractor use

The utilization of contractors to design and build new pipelines typically involves a high level of contractor utilization, but the role of contractors in operations, maintenance and support activities varies widely among pipeline companies. Factors that often support the use of contractors include work that is seasonal or highly variable as to the level of effort, tasks that are relatively unskilled and with a high manual labor content and tasks that require an unusual skill set making it hard for a company to develop and maintain an in-house competency. Other factors influencing the mix of employees and contractors include the availability of suitable contractors locally, the cost of contract personnel, including overhead and benefits, whether or not the task is viewed as a core competency that should be maintained in-house and any over arching management view on out-sourcing. Regardless of the reason for using contractors, the expectations regarding competency must remain comparable to those for employees and the OQ rule holds the operator responsible for the competency qualifications whether the task is being handled by contractors or employees.

Future work force issues

There are a number of work force issues facing the pipeline industry, many of which are being faced by other industries. As an example, the demographics of the employee population are such that a high proportion of the work force will retire during the next decade and replacing the attrition will be challenging with a smaller pool of candidates at the same time that employment standards are rising. A somewhat related issue is the shift from organizing the field work force along traditional craft lines to a more flexible, multi-skill approach. The former tends to be less efficient and more costly, whereas the latter can be more efficient and provide more opportunities for individual growth, but needs higher skilled individuals and more training. The role of unions, particularly international unions such as PACE (Paper, Allied-Industrial, Chemical and Energy Workers International Union), in the mix of represented and non-represented employees is another issue being faced by the industry. And various issues related to employee benefits, such as health care and pensions, are very much on the minds of employees and management.

Community Involvement

There may have been a short period in the early days of the pipeline industry when the interfaces with the public were limited, but for most of the history of the industry there has been an ever-increasing level of interaction. Today, separate from all the regulatory interactions, there are relations with the owners of the property traversed by the pipelines, with neighbors, near and far, with the responders (police, fire and others) for drills or if an emergency were to occur and with the direct and indirect consumers of the transportation services provided by the pipelines. Pipelines increasingly recognize how important it is to expend the time and effort to establish and maintain sound, open communications with the various interested publics. With few exceptions there are only minor differences in the objectives of the industry and the public, but the increasing urbanization, growing awareness of pipelines and the influence of the media contribute to an ever heightening of society's expectations of all industry, not the least of which are pipelines.

Communications

The leadership of the liquid pipeline industry has recognized the trend and the need, not only to respond, but also to get out in front with communications. To that end the industry has initiated and supported various programs to more effectively communicate with the public, educating them with regard to pipelines, creating forums for dialogs on issues of mutual interest and responding to the interests and expectations of the public. The communications methods employed vary widely, including the preparation of written materials that are distributed proactively (to right of way owners and neighbors, for example) or in response to inquiries, the creation of web sites for any interested party to learn more about an individual company or the industry (e.g. www.pipeline101.com) and visits and presentations to many subsets of the public. Depending on the audience the efforts meet with varying degrees of success. In some cases, the public seems disinterested in the communications overtures. In other instances, there can be a lot of emotion associated with pipeline issues and it is not always possible to come to a readily satisfying resolution or compromise among the various views. Nonetheless, the communication and outreach effort is recognized to be essential and must be continued.

Costs

The financial performance of pipeline companies is driven by revenue, which is closely tied to the volumes being transported for their shippers, and the costs to operate, maintain and upgrade existing lines and to build new ones. And what is revenue to a pipeline is an additional cost to the producer to get its crude to market, to the refiner to get feedstock to its refinery and to the marketer to get its refined products to the consumer. Consequently, in today's competitive transportation market, shippers (even in integrated energy companies) apply considerable pressure on the pipeline companies to keep their tariffs low and the shippers back up their demands through commercial (i.e. by using other transportation options) and regulatory (i.e. by challenging tariffs) means. The result is that pipeline companies are driven to manage their costs in order to attract business and to improve their bottom line. Another factor increasingly impacting the industry's cost outlook is the need for investment and reinvestment to meet a variety of needs, some arising from shippers, some from legislative and regulatory requirements and some from public demands.

For many years the single largest cost to operate and maintain a pipeline was for the fuel and power needed to pump the crude and products. During the last decade or so, pipeline companies have out-sourced many of the services previously handled in-house as a means to become more efficient and reduce their total costs. As a result, Outside Services was the single largest cost during the 1990s (22%), followed closely by Fuel and Power (21%). The cost of employees (Salaries and Wages at 14%) was next, followed by Supplies and Expenses at 9%. The FERC definition of "Supplies and Expenses" involves supplies consumed and expended in operations and includes expenses of aircraft and vehicle operations, travel and other employee expenses and related miscellaneous costs. The other 34% of operating and maintenance expenses are comprised of a wide range of miscellaneous costs.

Exhibit 14. Average Pipeline Cost Distribution 1990 to 1998

OPERATING EXPENSES	%	CAPITAL EXPENSES	%
Outside services	22	Pipe construction	35
Fuel and power	21	Line pipe	20
Salaries and wages	14	Other station equipment	12
Supplies and expenses	9	Oil tanks	5
All other	34	Pumping equipment	4
		Line pipe fittings	3
		All other	21
	100		100

Source: Association of Oil Pipe Lines

The distribution of expenses associated with capital projects is largely influenced by the cost of the pipe and equipment and the cost of constructing the facilities. During the 1990s the single largest capital cost category was Pipe Construction (35%), followed by the cost of Line Pipe (20%), Other Station Equipment (12%), Oil Tanks (5%), Pumping Equipment (4%) and Line Pipe Fittings (3%). The category "All Other" accounted for the remaining 21% and was comprised of a large number of smaller categories.

Capital Investment

Unlike the post-war period of the 1950s through the 1970s during which some 62% of the presently existing pipeline infrastructure was put in place, the 1980s and 1990s saw relatively small additions, 9% and 7%, respectively. The reasons included the decline of inland crude production which made considerable pipeline mileage available for other purposes, the ability to debottleneck existing capacity and the limited growth of refining capacity. Today there are emerging factors that may alter the situation and increase the industry's need to invest. These include a shifting, growing population especially in some areas of the country, the limited remaining ability to achieve incremental capacity growth by redeploying existing infrastructure and the extremely capital intensive development of large crude reserves in very deep water (5000' to 10,000') in the Gulf of Mexico. Other reasons include the issues surrounding the maintenance of older pipelines and the need to replace some portion of those systems, as well as the need to respond to the heightened public expectations of the industry that are reflected in legislative and regulatory requirements, including the development and implementation of expensive, cutting-edge technology.

Attracting sufficient capital to meet investment and reinvestment needs

The ability of the pipeline industry to attract sufficient capital to meet its investment and reinvestment needs will be strongly influenced by the balance of risk and reward perceived by potential investors. Whereas in the decades after World War II the large, often integrated, companies stepped up to meet obvious needs, such as investing $8 Billion to build the Trans Alaska Pipeline System, today many things are different. The integrated companies are much less of a factor in the pipeline industry and even for those that remain, the ability of a pipeline affiliate to obtain capital is more challenging, as every project needs to stand on its own and compete with expensive, high return exploration and production investments. Concurrently, the sources of capital have become much more diverse. Examples include companies not in the energy industry, public and private funds and small, individual investors who buy units in Master Limited Partnerships. The ability to tap those sources requires a clear understanding of the rewards (i.e. the returns) and the risks.

The rewards include a steady, long term cash flow and an acceptable return, especially for those entities with a lower cost of capital. And, although there are segments of the industry that have been contracting and restructuring, the outlook is for substantial growth in order to meet the rising energy needs of the country.

On the other side of the balance the changing nature of the risks facing the industry will make it more difficult to attract capital. Some business risks have existed since the inception of the industry and will continue. Examples relate to the cost and schedule for executing projects, the impact of operational upsets and the effects of competition on volumes and revenues. Risks that may prove to be more important factors in the future involve the difficulties of obtaining permits and rights-of-way, operations in more difficult environments (such as deep water Gulf of Mexico), the extreme design and operating requirements that may be imposed on operators and the difficulty of specifying and applying new technologies. There are other risks that also influence the ability to raise capital. Perhaps the most important for a pipeline (including its owners, officers and employees) is the ever-increasing liability that flows from any sort of operating problem having a safety or environmental impact. In our litigious society the implications of an incident are enormous and will color investment decisions.

Legislative and Regulatory Impacts

Since 1906 when Congress passed the Hepburn Act, oil pipelines have been declared to be common carriers and have been subject to the provisions of the Interstate Commerce Act of 1887, which had applied previously only to railroads. Congress' action responded to the public outrage resulting from John D.

Rockefeller's Standard Oil gaining control of 90% of the refining industry and 80% of the oil transportation business and employing a variety of anti-competitive practices. The Interstate Commerce Commission (ICC) was responsible for regulating the oil pipelines, including rates and charges, terms of service, the form and content of tariffs, accounting, reporting and limits on the disclosure of shipper information, but not the construction and abandonment of pipelines, sales and leases of pipeline assets, non-transportation services and securities transactions. With the exception of some pipeline cases in 1914, the ICC was relatively inactive with regard to oil pipelines until the 1940s. Among the more significant regulatory actions thereafter were the Atlantic Refining Consent Decree in 1941 (which limited the dividends that a pipeline subsidiary could lawfully pay to its parent, thereby effectively limiting pipeline rates of return), the ICC Valuation Methodology during the 1940s (which determined asset values for recovery through rates) and the Williams Pipe Line and TAPS proceedings of the 1970s (both of which challenged existing rate methodologies).

Economic Oversight

In 1977, the Department of Energy Act created the Federal Energy Regulatory Commission (FERC) and transferred responsibility for oil pipelines to FERC from the ICC. The DOE Act specified that the interstate transportation of oil by common carrier pipeline was to be regulated by the FERC, thereby excluding anhydrous ammonia, CO_2, water and a variety of other materials which are regulated economically by other agencies or are not regulated as to rates. During the early years of FERC's oversight, its regulatory efforts were quite limited. Then in 1985 FERC issued Opinion No. 154-B, which set a new cost-based mechanism and in 1988, in a case involving Buckeye, FERC introduced the alternative of market based rates for situations in which a pipeline could demonstrate a lack of market power and thus be permitted to charge market-based rates. But the time and cost of proceedings under each of these methodologies was significant.

Congress, by enacting the Energy Policy Act of 1992, altered the regulatory landscape by mandating that the FERC create a simplified and generally applicable rate methodology. The Act deemed most existing and unchallenged rates just and reasonable, which is known as the "grandfathering" provision. Late in 1993 FERC responded by proposing an indexing approach that was adopted in 1994. It utilized an index that was the Producers Price Index for Finished Goods less one percent (i.e. PPI -1%). The chosen index methodology was effective initially for five years and was subsequently extended for a second five year period. That extension was challenged, largely because the cumulative index (3.5% from 1/1/95 to 7/1/02) lagged actual cost increases. The U.S. Court of Appeals for the DC Circuit vacated the extension and on February 20, 2003 FERC announced that rates would be indexed using the new PPI index (without the minus one percent) for the five year period 2001 to 2005. The index allows pipelines to increase rates up to the index ceiling, largely without risk of challenge.

Common carriage

The notion of a common carrier flows from common law and subjects to regulation private property that is "affected with the public interest". A common carrier has certain obligations: to provide prompt and safe services, to be strictly liable for injuries, to avoid undue discrimination or preferences among shippers and to charge reasonable (i.e. not excessive) rates. The public also has obligations: to provide a fair return to the carrier and to arm the carrier with the right of eminent domain. And there are limits on the carrier's obligations, including: no requirement to continue in service and no requirement to expand, although a pipeline must treat shippers fairly if capacity is constrained.

While the indexing methodology has been the primary rate making mechanism since the mid-1990s, there are alternatives. The 154-B cost of service approach dating from 1985, market based rates and negotiated rates are all being utilized currently. The underlying requirement is that the rates must be just and reasonable, but there are many details and fine points that apply to each of the methodologies. These include the requirement that the service must strictly conform to provisions of the tariff (i.e. prorationing of capacity, demurrage, odorization, storage, handling, loading/unloading, blending, etc.). While undue discrimination is prohibited, some forms of discrimination, especially those aimed at responding to competitive pressures are allowed, so long as they are not "undue". These include proportional rate discounts, volume incentive discounts and favorable treatment for signatories of throughput and deficiency agreements. Through or joint rates also are allowed.

This discussion has centered on interstate rate making, which applies to about 80% of US oil pipeline mileage and volumes transported. The other, intrastate movements may be regulated by the respective states (often by a public utility commission, but sometimes with a different name, such as the Railroad Commission in Texas and the Regulatory Commission of Alaska) and most state statutes provide for generally similar approaches to economic regulation. An issue that sometimes arises involves decisions as to when a pipeline is in interstate versus intrastate service. Often the distinction is clear, but not always.

In addition to the more global interstate and intrastate issues, there can be some local economic regulatory issues, an example of which is franchise fees. In most cities utilities that have easements under the streets to distribute water, telecommunications, electricity and natural gas to consumers pay franchise fees to the city for the right to use those easements. Normally the fees are paid annually and can be substantial, perhaps a percentage of the value of the service being distributed. With few exceptions liquid pipelines do not use city streets as rights of way, although there may be numerous crossings of streets, especially as urban sprawl increases. In most places liquid pipelines pay a fee that bears some relationship to the costs incurred by the city to grant an initial permit and then to administer it thereafter. However, in recent years, as the revenue needs of cities have increased, many have tried to impose franchise fees. Litigation has ensued and for the most part the liquid pipelines have prevailed. The situation in California is different in that a system of franchise fees imposed on oil pipelines has been in place for many years.

Environmental Protection

The pipeline industry must comply with a wide variety of environmental regulations, some of which directly affect new and existing facilities, while others represent an indirect impact because the regulations relate to the materials being transported. The Environmental Protection Agency (EPA) has the largest role in such regulation, but many other federal, state and local agencies are involved, some of which establish standards while others are charged with enforcement. The list of federal agencies includes, in addition to EPA, the Office of Pipeline Safety, the Bureau of Land Management, the Army Corps of Engineers, the Minerals Management Service, the US Fish and Wildlife, the US Coast Guard and the US Forestry Service. The number of state agencies is similarly wide-ranging. Aside from the challenges of dealing with a large number of agencies, there are conflicts and inconsistencies among the requirements imposed. An example of an area of conflicting jurisdiction is terminals, which may serve more than one function. Most pipeline terminals are under the purview of OPS, but most marketing terminals are under the jurisdiction of EPA. Another example is that offshore pipelines come under MMS rather than OPS jurisdiction. Furthermore, all too often state and local agencies are not consistent with their federal counterparts and there are state-to-state variations.

Most direct environmental regulation deals with releases to the environment, whether occurring during normal operations and maintenance activities, during construction or as the result of unplanned incidents. The regulations cover releases to air (tank emissions; fugitive emissions from pumps, valves and other equipment; releases occurring when equipment is opened for operations and maintenance; “spills” of highly volatile liquids; etc.) and to water (discharges from treating facilities, normal run-off from a site, run-off during construction and spills), handling of toxic substances and disposal of hazardous materials. The regulatory coverage includes specifying limits on discharges and mandating procedures for obtaining approvals for new and modified facilities and for establishing and testing plans for handling operational contingencies. With the passage of time the regulations are becoming more demanding, tightening emissions limits, imposing additional requirements for the contingency plans and raising the expectations and standards for the operation of pipelines, such as the training and qualification of operating and maintenance personnel.

The indirect environmental impacts relate to the increasingly stringent specifications for refined products, such as reducing the permissible level of sulfur or other compounds in some fuels (such as low sulfur diesel fuel) and defining the composition of other fuels (e.g. banning MBTE, requiring ethanol addition, limiting RVP, etc.), particularly with respect to motor gasoline, in order to meet attainment standards in certain geographic areas. One impact of these new fuel requirements is simply the challenge of maintaining the integrity of a product, recognizing that only a slight amount of contamination will render the product useless and a candidate for reprocessing. Another outcome is the proliferation of grades of a fuel that require special care and handling which manifests itself in higher operational and maintenance costs and reduced capacity.

Safety Oversight

The growth in regulations related to the safety of pipeline operations and to the protection of employees, including contractors, and to the neighbors of pipelines is quite similar to the trend in the environmental area. Once again there are a multitude of federal, state and local agencies with an interest and a role and often some over-lap with the environmental regulations. With regard to worker safety the Occupational Safety and Health Administration plays the lead role, but others, particularly state OSHA organizations are involved. Safety of operations is primarily the responsibility of the Office of Pipeline Safety, but there are other agencies with an active interest, such as the Minerals Management Service for off-shore pipelines and state agencies such as the Railroad Commission in Texas that perform functions analogous to those of the OPS. Local entities, down to the level of cities and towns become deeply involved in contingency plans and drills for all sorts of emergency situations. As in the environmental area there are not always consistent standards and approaches among agencies and across state boundaries.

Impact of Technology

Throughout its 100-plus year history the pipeline industry has employed advances in technology, implementing new technology developed specifically for pipelines as well as taking advantage of developments in other areas and industries. Since the first pipeline was constructed, there has been a steady stream of advances relating to construction, operation and maintenance. Along the way there has been an increasing emphasis on new and improved techniques to reduce risk and there have been applications of technology aimed at managing costs.

Constructing and Maintaining Pipelines

Since the late 1800s, steel has been the material of choice for virtually all pipelines and tanks. The steel industry evolved rapidly in the late 19th century and as the steel making process improved, so did the quality of the steel, with stronger, tougher materials having fewer impurities and better welding properties becoming available. That progress continues with standards for the newest, strongest steel yet developed being adopted in 2002. The methods of converting steel plate into pipe have also changed a great deal. In the early days furnace butt welding and furnace lap welding were used to form the longitudinal weld on a section of pipe. There have been a number of improvements and today double submerged arc welded pipe is used and has a longitudinal weld as strong as the pipe itself. In parallel with improved materials and pipe fabrication there has been progress in coatings that protect the steel from the environment and enable an almost unlimited service life. Early coatings of mastic and tar have given way to fusion-bonded epoxies that provide a tough, corrosion resistant coating. Similar advances are employed in storage tanks to limit corrosion of the bottom and walls.

Improved steel and coatings

Construction

The methods of constructing pipelines have changed considerably from the early years when screwed joints, bolted flanges and other mechanical methods were used. In 1911 oxy-acetylene girth welds were first employed, but since the 1930s electric arc girth welding has been used. When pipelines are built the welds are checked by X-rays or ultrasonic probes to identify weld defects and corrections are made before completing the line. Then, before operation, the line is subjected to a hydrostatic test at pressures at least 25% higher than the maximum operating pressure to identify weak spots. Also, in-line electronic sensors may be used to identify construction defects. Analogous progress has been made in constructing storage tanks and other facilities associated with pipeline operations.

The evolution of the technology for constructing pipelines can be illustrated best by examples of pipelines that have been built in very difficult locations. A particular feat was construction of the Trans Alaska Pipeline System, the 800-mile, 48” pipeline from the North Slope of Alaska to the marine terminal at Valdez on Prince William Sound that was built during the 1970s. Half of the line had to be built above-ground as it traverses tundra that remains frozen all year, the right-of-way crosses three mountain ranges and numerous earthquake faults and the remote location of much of the line presented enormous and unprecedented construction challenges. Current examples are the lines being constructed to transport crude oil in the deep waters of the Gulf of Mexico, often in excess of 5,000 feet. Since it is impossible for humans to work at such depths the pipeline must be constructed on the surface, lowered to the bottom and then monitored and maintained remotely. Special materials, coatings, equipment and techniques have been developed and employed and the quest for new and better approaches continues.

During the past thirty years or so, the technology for inspecting liquid pipelines while in-service has advanced considerably. “Smart pigs,” or internal inspection devices, have become more sophisticated with progress in electronics, miniaturization and sensor technology. Today there are a variety of devices available to identify imperfections in the steel forming the pipe wall, such as surface defects created during fabrication or by corrosion since installation, or the existence of cracks that if not repaired have a potential to lead to failure. Besides the internal devices, there are a large number of other tools, applying all sorts of technology, to test and evaluate pipe, tanks, and equipment. Examples include ultrasonic and infra-red probes and vibration and gas detection sensors.

Monitoring and controlling pipelines

In recent years the technology for monitoring and controlling pipelines, tanks and ancillary equipment has evolved rapidly, taking advantage of developments in telecommunications and computer technology. Operating conditions, such as flow rate, temperature and pressure, as well as the condition of equipment, are determined by sensors that can be read locally and remotely. And control of equipment, such as valves, pumps and compressors, can be exercised manually, locally via programmable logic computers (PLCs) or remotely from sophisticated control centers. Most pipeline systems are now monitored and controlled from centralized control centers that employ state-of-the-art SCADA (System Control and Data Acquisition) systems. The operators sit at consoles with multiple computer screens and a variety of communications capabilities at their finger tips, controlling remote facilities and operations, conversing with employees in the field, viewing the status of operations and being assisted by computer programs that periodically check operating conditions and alarm when a significant deviation is noted.

Reducing Risk

The methods for repairing pipelines, tanks and other equipment have advanced, taking advantage of technological developments in materials, techniques and verification. The results are better quality, longer lasting repairs.

Repairing pipelines

The on-going development and application of new technology is vital to reducing the risks associated with pipeline operations. The industry is dedicated to systematically eliminating risks and a major contributor is application of results from the industry's research and development programs. Virtually all of the advances associated with constructing, operating and maintaining pipelines also play a role in managing and reducing risk. It is obvious that better materials, fabrication, inspection, monitoring and control are essential.

There are other areas that also contribute to reducing risk. For example, research into enhanced surveillance techniques continues in hopes of being able to spot weak links so as to avoid leaks, as well as to detect spills quickly, before they grow and have a large impact on the environment. Some of the leads being pursued include better computer leak detection algorithms, improved sensors for airborne application and satellite imagery. Another area of emphasis involves a multi-industry cooperative effort to reduce incidents caused by excavators damaging or puncturing underground lines and other infrastructure such as fiber optic cables. Better mapping techniques, more precise methods for locating lines, enhanced ways of marking lines, better information systems, and even tougher pipe are all parts of the solution.

A number of research initiatives are underway to identify and develop new and better approaches. The liquid pipeline industry is leading and funding some of the efforts directly, some are jointly funded with the natural gas pipeline industry and the government is funding still others, particularly the Office of Pipeline Safety and the Department of Energy. Several major universities also conduct relevant research programs.

Managing Costs

Improvements in constructing, operating and maintaining pipelines have a positive impact on managing the costs of operating and maintaining pipelines. However, there are other initiatives that can also contribute, examples of which include cost-effectively increasing capacity, reducing energy consumption and finding more economical ways to maintain facilities.

DRA improves pipeline capacity

Seeking low-cost ways of squeezing more capacity out of existing lines has always been an objective. Systematically removing bottlenecks, raising operating pressure by modifying, adding and improving pumps and by looping some line sections are examples. However, a different approach represented a large breakthrough in the 1970s when the controlled addition of a small amount of a long-chained molecule was found to reduce the friction in a pipe, thus increasing the capacity in most cases. The additive, known as DRA (Drag Reducing Agent) has been employed in many crude and product pipelines and continuing research is aimed at finding even more effective DRA compounds, requiring less additive and more benefit.

Power management

Power, representing a large cost for pipeline operators, is a major area of emphasis. One thrust has been to employ equipment that uses less electricity, such as more efficient motors, variable speed motors and other equipment that requires less power. A second approach is aimed at managing the consumption of power by using sophisticated, computerized monitoring and management systems to reduce peak demands and to utilize interruptible supplies.

Maintenance management

Opportunities to lower costs by enhancing maintenance activities cover a wide range of examples, from simple to quite sophisticated. At one end of the spectrum there are complex, computer-based maintenance management systems that track equipment performance and maintenance history and enable the application of preventive maintenance, thereby largely eliminating the costly repairs necessitated by breakdowns. An example at the other end of the spectrum relates to the need to maintain pipeline rights-of-way through use of improved herbicides to manage the growth of vegetation and the use of helicopter mounted side-cutting tools to trim trees along rights-of-way. Between those examples is a long list of other approaches that employ new technology.

Summary --- The Outlook

During the first quarter of the 21st Century the demand for refined products will grow considerably, crude production will decline overall, although deep-water production will increase, and refining capacity will become more concentrated in major coastal refining centers and only grow modestly. And petrochemicals will continue to grow rapidly with the economy.

A short summary of the Energy Information Administration's Energy Outlook 2003, comparing 2025 with 2000 helps to put the outlook for liquid pipelines in perspective. During that period, refined product demand in the US is expected to increase 9.5 million barrels per day (48%), with more than 2/3 of the increase being for transportation fuels (motor gasoline, jet fuel and diesel). Domestic crude production is forecast to decline 0.5 million barrels per day (8%), with inland production forecast to decrease 900 thousand barrels per day (22%) and offshore production up 400 thousand barrels per day. However, during the period offshore production will be up as much as 1 million barrels per day. Refining capacity is expected to increase 3.3 million barrels per day (20%) despite the shutdown of additional smaller, inland refineries that EIA has not specified. The combined forecasts of product demand, crude production and refining capacity imply crude imports will increase 4.0 million barrels per day (45%) and refined product imports will increase 6.3 million barrels per day (380%).

The overall changes during the first 25 years of the 21st Century will impact the regions differently. Most of the decline in inland crude production will take place in PADD III, with some in PADDs II (Oklahoma) and IV, and the growth in offshore production will be in coastal waters off Texas and Louisiana (PADD III). Most refining capacity growth will be in the major coastal refining centers in PADD III, driven by the decline in inland crude production, the location of the demand growth and economies of scale favoring expansions. Thus there will be modest increases of Canadian crude imports into PADDs II and IV and of other crude into PADD V, but much of the increase in crude imports will be into PADD III. The increase in product imports will be predominantly into the East Coast, especially the mid-Atlantic and New England, and the West Coast.

The implications for crude transportation are the addition of large, expensive pipelines in the Gulf of Mexico, considerable additions of large, short lines between marine terminals and coastal refineries to handle crude imports and some additions of crude transmission infrastructure along the Texas/Louisiana Gulf Coast. Disinvestment in inland gathering and associated crude transmission systems and modest asset redeployment and re-investment associated with transporting domestic and foreign crude in PADDs II, III and IV can be anticipated. For refined product pipelines, the implications are expansions, in some cases significant, to move imported product from coastal terminals to inland consumption points and expansions of product transmission capacity from the

Texas/Louisiana Gulf Coast refining centers to the Southeast and the Mid-West, perhaps an interconnection to the southern portion of PADD V (Arizona and southern California) and some movements into the Rocky Mountain region. And the refined product situation is likely to be complicated by further changes to the number and quality of products being transported in response to health and environmental requirements. The network of pipelines providing feedstock and carrying petrochemical products, especially along the Texas/Louisiana Gulf Coast, will continue to expand rapidly. The investment in inland pipeline capacity, primarily for product service, will replace some existing capacity, but much of the existing pipeline network will remain in service. Thus, the existing infrastructure will continue to age, although enhanced inspection and repair techniques, selective upgrades and replacements and more sophisticated operational control systems will enable those pipelines to be operated safely.

The ability to expand the liquid pipeline network and to update the aging infrastructure will be ever more difficult. Increasing urbanization, ever higher environmental expectations, and a decreasing tolerance for siting industrial facilities will make the acquisition of pipeline rights-of-way even more challenging. Implications will include more expensive projects that take longer to develop and that involve a great deal of litigation.

In conclusion, the outlook for the liquid pipeline industry in the US is for ever improving environmental and safety performance, albeit at the same time that the public's expectations continue to rise rapidly, with little tolerance for operational incidents. An already diverse industry is likely to become even more so, especially as it relates to the number of product grades, the number of shippers, the entry of many new carriers, the growth of MLPs and the diminishing role of the major, integrated carriers who will continue to shift their emphasis toward major transmission lines and complex, capital intensive deep-water Gulf of Mexico projects, and away from inland crude gathering and older, smaller systems. Increased competition and a need for cost control will increase the importance for industry participants to rely on objective, impartial decision making and will diminish further the need for economic regulation, although the need for open access and the posting of tariffs will remain. Issues relating to rights of way will become even more contentious and expensive.